Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. LXXI, No. 1

STUDIES IN CORAL REEFS

By J. Stanley Gardiner
Cambridge University, England

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM
August, 1930

No. 1.— *Studies in Coral Reefs*

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Introduction

The studies which follow were never likely to have been published had I not been enabled, by an invitation to give a course of lectures at the Lowell Institute, Boston, to work for six weeks in the Museums of Comparative Zoölogy and of Geology of Harvard University. My views were postulated, but I felt averse from publishing them owing to the scanty material at my disposal. These museums, however, contain the collections which were made by Louis Agassiz and by Alexander Agassiz on many expeditions. There were in particular a fine series of deposits from the Maldives, together with numerous samples of beach sand and all kinds of rocks, all of which were put up by Henry B. Bigelow with accurate labels. All of this material I have been allowed to open up and examine, while at the same time I have compared it with the better known deposits, sands, and rocks collected on the numerous Atlantic and West Indian expeditions ("Hassler," "Blake," "Albatross," etc.), by this means checking my results. I have been given the fullest hospitality and allowed to browse at will on these collections, and I desire to express my thanks to Professors Thomas Barbour and Reginald A. Daly. To the former and especially to Professor Henry B. Bigelow I am under peculiarly deep obligations, while every member of the staff of the Agassiz Museum helped me in kindred subjects, which I am now considering.

To Alexander Agassiz I am indebted for great encouragement from 1898 to 1910. I regard him as a great man, and I am convinced that the whole subsequent history of the "coral reef problem" would have been altered, had he been enabled to publish the "conclusions" he obtained from over thirty years of continuous work. The examination of his material that I have now made allows me to testify to the accuracy of his published work. There is throughout it a peculiar vein of caution, and the statements therein contained must be taken literally. He visited many tropical island groups and reefs, and the appearances he saw are described. His surveys were rapid, but he tries everywhere to state the facts as he sees them without prejudice. In many directions he broke new ground, and he gives us a general view of the tropi-

cal seas as a biological entity, leading to that intensive study of particular areas and of particular animals and plants that became fashionable amongst his successors.

1. *Shoal Formation in Atoll Lagoons*

The study of the Mascarene coral reefs led me to the reëxamination of all specimens of the bottom and of all dredged corals and other materials in my possession from the Indian Ocean. In particular, I had a valuable, if seemingly small and discouraging, collection of information and specimens, obtained by Mr. C. Forster Cooper from the lagoons of S. Male to Kolumadulu, Maldives, he having concentrated on the nature of lagoon floors, when he was in sole charge of our vessel. These contained recently killed and half dead reef corals, in spirit; there were also broken off pieces of algaé, some dead mollusk and echinoderm shells, muds, sands and other deposit material. Cooper also bottled some crustaceans, worms, mollusks and star fishes, with *Dendrophyllia* and several species of solitary corals, all of which were dispersed to systematic workers, the corals coming to me. I am filled with admiration for Mr. Cooper's persistence in this work, day after day driving a native crew for five weeks. His material, on which my subsequent suggestions are largely based, has been immensely reinforced by the examination of Professor Alexander Agassiz' deposits from the Maldives, which include specimens from some of the atolls examined by Mr. Cooper.

All atoll lagoons have some shoals, and these are more numerous near their encircling reefs. Where a small horn of a lagoon is nearly enclosed by reef, there may be a shallowing of its waters and many closely set shoals. This is often more noticeable still, as in the south horn of Funafuti, where the greater part of the reef is crowned with land. In such places shoals may be packed between with detritus and added to the encircling reef. In the central sixty or seventy square miles of Funafuti lagoon there are twenty shoals, nearly all of which reach the surface, many being mere peaks, their total area not more than two per cent of the whole. Nearly all these shoals in lagoons arise perpendicularly in their upper few fathoms, falling steeply below to the bottom plateau of the lagoon. There may be some screes, broken-off material from the same, but there is little or no indication of any probability of the upgrowth and outgrowth of such shoals at deep levels by living organisms.

In contrast to the bottom and deep levels of the lagoon shoals, their

upper faces are covered with growing reef corals, also *Millepora*, *Heliopora*, and alcyonaceans, carrying a rich fauna of crustaceans and tiny fish. Spaces between sedentary organisms are filled in with *Halimeda*, the fronds of which have a lime skeleton, and this may be by far the most abundant organism present; Lithothamnioneae, when living in such positions, are of only very minor importance. There are many crevices left between the upgrowing organisms, but often even a large shoal presents no dead surface and no area of sand accumulation, though the latter fills up all spaces. A similar appearance is presented by the lagoon edges of the encircling reefs of many large atolls, where these reefs are clear of islands and so afford a clean sweep to the ocean waters. Such areas should show a bottom deposit of mechanically carried sedimentary material, but frequently there are flat-topped limestone masses with vertical faces, quite similar to those described and figured by Surgeon Paradice within the seaward face of the Great Barrier Reef,[1] where their summits show various depths down to a few fathoms; they are presumably growing up.

It will now be clear that the lagoons of atolls, while presenting areas of almost inconceivable barrenness, show some shoal parts, literally covered with the gaping mouths of animals. It is impossible to believe that there is that paucity of food in lagoons, due to the innumerable mouths on the encircling reefs, as supposed by a long succession of writers. The "Sealark" took samples of plankton at each hour of the night at each of her numerous anchorages, using generally both sixty and one hundred and eighty mesh to the inch nets. Some of these were within and others outside lagoons, but the total amounts of plankton were approximately the same in these two environments. This was noticeably the case in such animal groups as I sorted out, viz. Chaetognatha, Medusae, Crustacea Decapoda, Tunicata and Annelida, and I have recently confirmed this statement for residues, mostly Entomostraca in bulk; I do not know whether there is this equality in diatoms.

Furthermore, it is impossible to believe that in lagoons there is such an absence of oxygen or presence of carbon dioxide as could be inimical to the reef-building organisms, whatever analyses may be made of open lagoon waters. The presence of carbon dioxide, if found, would indeed be beneficial to plants and almost equally so to reef corals, all of which possess commensal algae in their tissues. The importance of these organisms in the biology of reef corals, suggested from crude experi-

[1] Trans. Roy. Geogr. Soc., Australia, **1**, p. 152, 1925.

ments at Funafuti and Rotuma in 1897 [1] has been proved by the accurate and modern experimentation of Dr. C. M. Yonge and his party on the reef corals of the Great Barrier Reef [2] where the commensal algae may even give off excess oxygen into the sea water from the splitting up of carbon dioxide, possibly thereby benefiting *Millepora* and *Alcyonaria* which, while not possessing algae, are often important reef builders or protectors.[3]

The central lagoon shoals are referred to above as all reaching the surface, and this in most atolls is literally the case. In all our dredgings we found only one intermediate depth upgrowing shoal in the middle waters of the lagoons of such atolls as have a single and fairly complete encircling reef, though they have been found near passages in that reef. In that congeries of reefs and small atolls (*faro*), which build up the so-called atolls of the North and Central Maldives, the case is the same, though some depths are quite suitable for the organisms which build coral reefs. In that extraordinary "jungle" of reefs in North Mahlosmadulu, visited by both Professor Agassiz and myself, water channels of deep blue contrast with the light coloured shining reefs. Minute surveys of Diego Garcia and Salomon (both Chagos) and of Funafuti confirm the existence of few but surface reefs, these being the only atolls properly surveyed for these considerations. The charts of other atolls agree so far as they go, but as a rule anchorages alone have been properly sounded. A striking instance is the lagoon of the Great Barrier Reef of Australia, where the inner channel near the land is a regular route for ships for one thousand miles, and which, in consequence, has been examined for dangerous reefs and banks. There are practically no invisible dangers, whereas most areas, granting the possibility of foundations, are apparently quite suitable to coral reef growth, and the organisms to colonize them are present in abundance on the fringing reefs of shore islands and on the outside barrier complex.[4]

The depths of lagoons vary, but each would appear to have its own characteristic depth, which except for surface shoals exhibits relatively little variation. There may be slight undulations, and there may be shoaling in bays or pockets in the encircling reefs, but on the whole the

[1] See Gardiner, Proc. Camb. Phil. Soc., **9**, pp. 480–484, 1898.

[2] See Yonge, Nature, pp. 91, 767, 1929.

[3] The possibility of commensal algae being of similar importance in bottom-living Foraminifera should be considered; at present they are known in few species and have scarcely been studied. See J. A. Cushman, Proc. U. S. Nat. Mus., **57**, p. 154, 1920, and Dept. Mar. Biol. Carnegie, **311**, p. 10.

[4] This, as indeed are all lagoons of barrier reefs, is complicated by land drainage, the fresh waters pouring into them carrying mud in suspension, while any carbonate of lime held in "colloidal solution" will be precipitated, where the fresh water blends with the salt water.

term "flat bottom" is justified. "Hard bottom" is frequently recorded on charts, and often the tube and snapper leads fail to secure any deposit. There may be relatively as great variation in the nature of the bottom as there is in the sizes of atolls, and in the depths of their lagoons which vary down to about fifty-five fathoms. In some places there may be sedimentation, filling predominating over removal of material, but few lagoons show evidence of this. In the Maldives there is a seemingly critical depth of twenty-five to thirty fathoms, above which any deposit is clean white material, broken up reef organisms, including the fronds of *Halimeda*, reinforced by pelagic and bottom Foraminifera and other bottom living organisms.[1] Below this depth the bottom becomes rather grayish blue and sticky, having a deposit of the same constituents, with the addition of a varying amount of mud. Now mud is characterized by the size of the grains which compose it. By the aid of an agate mortar we can make a quite good mud from coral sand, with most of the grains capable of suspension for a considerable period of time in salt water. This deep Maldivan mud is different for it has materials to which, in the present state of knowledge, the term "amorphous" may be applied and to which in most samples the stickiness seems to be due.[2] By dredging we found that it has almost no living crawling and sedentary animals upon it, but there were occasional dead mollusk and other shells, dead corals, etc.; it has no burrowing worms or bottom living foraminifera, etc., so far as I can judge from Professor Agassiz' material. Evidently there is some killing substance here and the only possible association is with this amorphous carbonate of lime.

A similar looking amorphous form of lime often is found on the surfaces of reef coral polyps and seaweeds, both of which are to some degree dependent on chlorophyll for their nutrition, and all our dredged material of such, especially from the Cargados bank, had to be brushed clean. Indeed this white slime was usual on dredged specimens of the same organisms and was always to be found below about ten fathoms and occasionally on quite shallow growths; we commonly ascribed any death in these organisms to it. It gives a dirtiness to the surfaces of the coral's tissues and seems to stick to them and to penetrate between the cells, which are ill-defined in the ectoderm; the plants' surface appearance as judged on *Udotea* and *Halimeda* is similar. We did

[1] As compared with similar depths in the North Atlantic or indeed in any open sea, the lagoon floor is a singularly barren area.

[2] The amount present is less than 1 per cent, while .1 per cent gives stickiness. These figures are judgment figures by the Murray method, founded on microscopical examination, not on accurate measurements.

not find it clinging to the tissues of *Heterocyathus*, *Heteropsammia*, *Flabellum*, *Dendrophyllia*, and *Millepora*, all genera without commensal algae, from ten to twenty fathoms, and the first two were found in large numbers with few dead forms. On the other hand, Professor Matthaei, in working through the Astreidae found three colonies partially killed by it, and I have found it clinging to the surfaces of *Pocillopora*, *Acropora*, *Pavona* and *Porites* from the same depths, these genera having commensal algae.

So far as I have seen, ordinary sediment, composed of the fine grains of aragonite and calcite, does not kill corals and plants except as a quantitative proposition, but the tissues do not have the same facility in getting rid of this clinging amorphous lime. It exists below twenty-five to thirty fathoms in coral atoll lagoons and is the sole cause to which I can ascribe their inconceivable barrenness. At shallower depths it is not recognizable in deposits and its clinging and killing properties seem largely or entirely confined to reef chlorophyllous corals and plants.[1] I have no determinate case where I can ascribe destruction as due to it on shoals within wading depths, or in very shallow waters, or in the passages of atolls, or indeed in any but relatively still waters.[2]

The outcome of those considerations is the following suggestion, viz., that the phytophagous corals and plants that build coral reefs precipitate amorphous carbonate of lime from the supersaturated sea water owing to the chemical operations of chlorophyll on carbon dioxide and that this material by clinging to their surfaces ultimately compasses their deaths in lagoon conditions beyond five to ten fathoms. In other words the physiological action of the chlorophyll feeding of the important reef building organisms at all depths beyond five to ten fathoms is such as to kill them by a simple chemical reaction in the sea waters which lave them. If this be so, it is obvious that shoals cannot be built up on lagoon floors from depths beyond ten fathoms. In any case this seemingly amorphous carbonate of lime is singularly

[1] The tissues were microscopically examined by surface inspection, teasing, hand sections and paraffin sections of undecalcified coral polyp tissues. This slime is on the surfaces of the Lithothamnioneae; I have seen no definite relationship to tissues here.

[2] I am indebted to Professor W. J. Crozier for the following suggestion: It is not impossible that in shallow water, subject to wave motion and turbulent flow, the mechanical stimulation of the polyps leads to a more or less continuous output of slime (mucus), which may remove sediment or precipitated $CaCO_3$. It may be that in still water failure to renew the mucus layer with rapidity may permit a firmly adherent layer, with entangled precipitated material, to form over the whole surface of the animals. This appears to correspond to what one sees when corals (*Isophyllia*, *Porites*, etc.) are kept in aquaria with flowing water, as contrasted with those kept without circulation.

fatal to organisms, and it is clear that search must be made in the biology of the reef-building corals and plants for an explanation of the bareness and the flatness of the lagoon floors of atolls since they do not — and therefore presumably cannot — live there.

2. *Coral Reefs and "Continental" Slopes*

The seaward slopes off nearly all coral reefs are such that these structures are described in survey publications and in "Sailing Directions" as "steep to." This means that the visible edge of a surface reef, which is a flat at sea level, slopes off in a distance of not more than a cable (200 yards) to the one hundred fathom line of depth. Any greater breadth or shelf to seaward of a reef and within the one hundred fathom line is always carefully mentioned. The greater part of it is certain to have a depth of less than forty fathoms, this being about the average depth at which the real steepening of the external slope of a coral reef commences. Any survey vessel pays attention to such shallow water round reefs, delineating it by soundings as carefully as possible, since it forms potential anchorage for sailing ships, which might not be able to make the lagoon owing to contrary winds, even if there be a suitable passage through the reef for their entrance.

Below this shallow upper shelf comes the "steep," which may have any angle up to 45° and which continues down to one hundred and twenty to two hundred and fifty fathoms, then merging gradually into the surrounding bottom. This steep would seem to be a talus slope, its angle being that at which loose material from the shallow water above can be deposited or piled in such positions. The submerged banks that have been properly charted have never had lines of soundings run for either scientific or cable laying purposes, but there are a sufficiency of soundings over and off such in coral reef regions as to justify the inference of the existence of similar steeps off the same. The graph of the whole slope from the top of the steep to seven hundred and fifty fathoms, assuming a general depth of more than 1,500 fathoms in the surrounding ocean, is concave, though there are some possible exceptions to this rule.[1] In contrast to this, volcanic island slopes have a tendency to give a convex or straight graph. Unfortunately I am unable to state that any one particular slope is characteristic of continents or of islands of some antiquity, reliable sections being few and oceanic effects varying greatly.

[1] Vide illustrations and discussion in Gardiner, "Submarine Slopes," Geogr. Jour., **14**, pp. 202–219, 1905.

A difficulty in respect to certain exceptional slopes off coral reefs, these simulating those of continents and high islands, is the determination of definite criteria, upon which deductions can be based as to the horizontal growth of coral reefs, progressive or regressive. Our period of accurate surveys has not extended through more than one hundred years, and most supposed changes within such a short time may be within the limits of error. Crossland, discussing Tahiti reefs, is quite certain that he has marked loss to seaward in progress, basing his deductions on his general biological knowledge and experience extending over twenty years' residence in Zanzibar, Pemba and at Dongonab, Red Sea, where he has studied similar phenomena. He also finds basaltic blocks being abraded out of the sides of the channels or trenches, which everywhere cut into the seaward edges of this barrier reef — and these must be deemed to settle this matter if confirmed.[1] Unfortunately the French surveyors have not laid down with accuracy the position of the one hundred fathom line here, and hence we can get no proper confirmation of Crossland's views from the external topography.[2]

For my part the only criteria I can suggest for regression are cliffing of the reef edge to five fathoms or more and any extensive sharing of coral sand material in the formation of the rock, either in this position or on the reef flat behind, since the reef, if growing outwards, is formed of corals and Lithothamnioneae, any inclusions of sand being small. Negroheads, masses of the reef edge broken off and thrown up onto the reef flat in storms in the Maldives, show this structure. In the same region the reefs have shallow trenches up to six feet deep, but on the whole gradual slopes. These trenches have not bare walls; they are not being abraded away, being covered with growing corals and Lithothamnioneae. To make the proper examination for accurate determination of these matters under breaking waves is impossible — and my statement that I believe that all the reefs, except the fringing, round and between Mauritius and Farquhar to the Seychelles are regressing is of no scientific value, being founded on no properly proved facts, although some small negroheads off Coetivy were not coral but sandstone.

[1] Vide Crossland, "Coral Reefs of Tahiti, Moorea and Rarotonga," Jour. Linn. Soc. Zoöl., **36**, pp. 577–620, 1928. Some discussion of the whole question will be found here, with references.

Mr. G. W. Otter, after twelve months on Low Island with the Great Barrier Reef Expedition, visited Tahiti at my suggestion. He confirms Dr. Crossland's facts and agrees as to the above deductions.

[2] Crossland (p. 669) mentions that "the reef of Rarotonga is peculiar in having a shelf with 5–30 fathoms of water outside it." The reef appears to be stationary, not gaining or losing.

The Great Barrier Reef seems to show a critical area about 16° S. near Cairns, and it was in this region that we established the expedition of 1928. The director of the Marine Division of the British Meteorological Office, Captain Brooke Smith, informs me that this area to seaward seems to be a marine area of disturbance, perhaps a meeting place of currents due to differences in chemical and physical conditions to the south and north. Topographically, the reef to the north is "steep to" on its seaward face and an almost continuous line with relatively narrow passages. To the south there is no continuous reef, but a series of small isolated reefs with broad channels between. The line connecting the outer part of these reefs is situated five miles or more within the one hundred fathom line. In other words these reefs cannot be suggested as capping the border of the continental shelf or as having the same topographical relations or formation as to the north. Actually, off Cooktown, these outer reefs were visited by Dr. Manton in 1929 and the impression received was that in this region loss exceeds gain,[1] though to seaward there is luxuriant coral growth.

On the west coast of Australia there is a continental contour comparable to that on the east side, but all islands and reefs are situated several miles back from its edge as delimited by the one hundred fathom line. The best account of any one group here is that by Dakin [2] of Houtman's Abrolhos, which traverse the line of 29° S. Dakin noted certain places, where he thought surface reefs were extending seaward, but informed me that he considered these exceptional, as indeed his whole paper assuredly indicated. This same continental region has a mild development of inner stone reefs, parallel to the shore, possibly analogous to that great series which lie along the Brazilian coast, off which is found a similar broad continental platform from 18° S. to the Amazonian region, its surface broken by the Brazilian Abrolhos, the Rocas atolls and other coral reefs. It is clear that there are here abundant coralline organisms, both animal and plant, to form reefs as off West Australia, but the only actual reefs are far within the continental shelf in shallow waters.

Tonga might be drawn in for "pleadings," as showing similar broad shelves of shallow water to seaward of surface reefs, but J. J. Lister and Alexander Agassiz, both of whom visited the group, pointed out to me that their great variability might be attributed to their active vulcan-

[1] Professor Richards, Brisbane, who knows more of this region than anyone in existence, has written to me that he is more and more coming to the conclusion that geologically different explanations for these northern and southern parts must be sought. My subsequent suggestion is purely biological.

[2] Jour. Linn. Soc. Zoöl., **34**, pp. 127–180, 1919.

ism; the latter strongly deprecated "one supposition after another." A few charts of the central Pacific, prepared in connection with cable laying, show the submarine topography with accuracy and justify the term "steep to" as applied to them. Indeed, the same description is used by the surveyors for most coral atoll slopes of this region, and there is no reasonable doubt but that it is justified in most or all cases. To some of the reefs lying near the northern and southern limits of coral growth the same term may have been applied, but its accuracy is doubtful. Indeed, there are odd soundings outside many of the southern reefs, which indicate the existence of a broad shelf between the reefs and the 100 fathom line; this is especially the case off Oeno, Ducie, Henderson and others to the south of the Paumotuas. Midway Atoll in 28° 13′N. has a broad platform at 30–50 fms. outside its encircling reefs, and Kure in lat. 28° 26′N. has indications of a similar topography. Indeed, the charts and accounts of these western reefs of the Hawaiian region (Nihoa, Necker, French Frigate Shoal, Lisiansky and Laysan) indicate that they may well have wide shelves of shallow water to seaward of their reefs.

The WSW half of Mauritius has no reefs, but a "continental" shelf, while the other half has fringing to barrier reefs with a broad shelf outside their edges. The differences in breadth of these two shelves, that to the ENE being the broader, may be due to physical causes, but I am unable to suggest any such. Lastly, Rodriguez has fringing and barrier reefs and outside these the same broad shelf. The best scientifically investigated high island with reefs known to me is Tutuila, Samoa,[1] and applying the criteria used there convinces me that subsidence must not be postulated to explain the presence of the Rodriguez bank.

In the above remarks I have called attention to certain facts relating to the topography of oceanic slopes common to a series of southern reefs and perhaps to the most northern, and for which a common explanation may be expected. These slopes are clearly due to conditions quite foreign to the vast majority of coral reefs. They do not exist, except perhaps in places off Australia, by virtue of the very recent destruction and horizontal removal of surface reefs to seaward of the banks in question, because, if so, some assuredly would have indication of the lagoons which they must have surrounded.[2] Yet these submarine con-

[1] See Mayor, Daly, Chamberlin and others. Marine Biol. Carnegie Inst., Washington, **14**, 1924.

[2] An example of this can be seen by reference to the chart of southern Ceylon. Surgeon Paradice's sections of the Great Barrier Reef in Trans. Roy. Geogr. Soc. Australia, **1**, pp. 52 et seq., 1925, seem to show the same but I have not yet seen the actual survey. They do not affect the argument, it being immaterial how reefs are washed away.

tours have undoubtedly the depths and steeps characteristic of coral reef topography, and we are therefore driven to the conclusion that they must have been once capped by organically formed reefs to within a few cables of their one hundred fathom line. In some places we are bound to suggest that they have been washed away to such a degree as to leave a straight slope, and in others driven back on lagoons and islands by vertical destruction of their seaward faces.[1] Other explanation than organic growth and accumulation of organically formed detritus for the existence of many of these shallow banks seems impossible, and the impressions or proofs of regression of existing reefs by several workers are not to be lightly ignored.

At present the only possible known cause of regression is temperature as affecting the reef building organisms. Most of the places cited have a temperature fluctuating near the critical point for reef corals, and great reefs off western Australia might well have been removed by a change, an inshore set, in the current which runs northward there. Temperature is my first "supposition," and it may help some investigator to be able to laugh at what I claim to be the logical deduction for my facts and "supposition," viz. a present and actively increasing glacial period for the Southern Hemisphere — and perhaps the Northern as well, though the facts as to the latter and perhaps for both may be explained on other grounds.[2]

3. *Beach Sandstone* [3]

Beach rock is a characteristic structure of tropical sandy shores, especially of the lagoon beaches of coral islands, where the beach is

[1] The whole atoll or barrier reef may be removed to 30 or 40 fms. Alternatively, its outer face may be cut back, while its inner edge may grow into its lagoon, the reef thus retaining approximately its breadth. Examples of each condition are given above.

[2] Daly, R. A. Pleistocene Changes of Sea Level, Am. Jour. Sci., **10**, pp. 281–313, 1925, suggests a six-meter lowering of sea level, 3,500 years ago. Nearly every large coral island gives evidence of a eustatic shift, but the amount varies with latitude and neighboring topography. For my own part I do not think that any habitable coral islands would exist today were it not for this, but I would only agree to the above as the date of its commencement, believing that this same shift is still in progress today.

[3] This rock has been referred to by nearly all the classical investigators of coral reefs. Later Professor R. A. Daly, "The Geology of American Samoa," Carnegie Inst. Pub., p. 340, 1924, discusses the formation of beach rock and the suggestions therein made should be read with his considerations and references; there may well be several modes of formation of beach rock. I might also refer to one of my fuller and later descriptions, which probably Daly never saw, Fauna and Geogr., Maldives and Laccadives, pp. 341–346, 1902 (illustrated).

The precipitation of carbonate of lime from fresh waters, where they meet the sea waters, is a common phenomenon known to all sailors on the east and south coasts of England. Large tracts of water become milky white and thus reveal the line of flow of the fresh water over the salt. Off rivers definite bars often form, shifting perhaps with changes of wind at different seasons.

gradually being washed away. It consists of sand, often pure limestone, often mixed, but always in all regions with a considerable quantity of carbonate of lime. So far as I have seen in the tropics some stretch of limestone country behind is necessary. The grains composing the hard sandstone visible in a beach are consolidated by carbonate of lime, usually in the form of aragonite, scarcely ever of calcite.

The sandstone forms layers on the exposed faces of beaches between tide marks, the layers dipping as do the beaches. In places where the beach is actively washing away, the same dip is preserved, though the beach on either side of a line of rock may have become much steeper. The flat tops of three, four or more layers are often exposed at the top of a beach, the spring tides sweeping them clear of sand. The layers vary in thickness, but the average is about five inches. The outer layer is the hardest and is separated from the next layer by a crevice, parallel to its exposed surface; it also develops vertical cracks. In consequence there is a flaking off of the outer layer, and flat slabs in various stages of destruction may strew the beach below. In Malé, the capital of the Maldives, the natives cut artificial channels, a few inches deep, around square blocks of sandstone, always leaving a drainage channel. The sea flows in these at high tide, hardening the rock greatly; it seemingly infiltrates underneath them and in a year or two they split off.[1]

The exposed parts of beach sandstone are all well hardened, but, if a section is cut through a thick formation, the sandstone continues rather indefinitely into its depth, and ultimately after three or four layers in depth, not usually more, rock gives place to loose sand, similar to that in the land behind. If the outer layer flakes off, the next layer hardens up, and there is further consolidation in the loose sand below. This and all consolidation, where there is a definite sandstone formation, is a

[1] The formation of the layers in beach sandstone, less consolidated from seaward inland, is usually ascribed to water rising over the top of a layer and gradually filtering in behind so as to eat out a crevice by solution, for there is no metamorphosis of limestone here. Support is sought for this in the deposition of $CaCO_3$ on either side of a crevice, resulting in greater hardening of the surfaces against it. I have never deemed this satisfactory and have in teaching referred to this as cracking parallel to exposed surfaces, as I could see no likelihood of infiltration and no probability of shrinking to produce cracking.

On consulting my friend, Mr. Carl Pantin, he presented me with the following ingenious suggestion which he based on chalk: "Calcium carbonate, being very alkaline, must attract to itself some calcium bicarbonate round all surfaces. Any mass of precipitated limestone must hence also have an appreciable amount of bound water and carbon dioxide as bicarbonate. On subsequent exposure to the atmosphere carbon dioxide could be liberated and this would cause a considerable contraction in volume in the interstices of the chalk, water being also freed. Finally this or other water dissolving the carbon dioxide can give repetition of chemical processes and carry calcium carbonate in solution from one place to another." If cracks form in beach sandstone, it is easy to see that their surfaces will be greatly hardened by the $CaCO_3$ precipitated on the drying up of the sea water.

matter of the evaporation of the sea water between tide marks; from seaward it proceeds inland.

At the bases of dunes a sandstone with certain resemblances and dipping more or less as does the sand of the dune was found near Kankasanturai, north of Ceylon,[1] in Farquhar and in Coetivy. In the latter two islands the sand dunes had been blown up on phosphatized coral land, which is very flat and hard, "platin" land as we term it, and in Ceylon they were on raised reefs, all localities above tide level. This dune sandstone was all covered by loose sand, of which a thickness of at least four to six feet seemed usual. We dug down through the top of one dune in Ceylon, but only found our formation round the base where its deepest parts were best consolidated. Clearly this sandstone can only be formed by the evaporation of fresh water, saturated with carbonate of calcium.

Minikoi,[2] an isolated atoll due west of Ceylon, has a long crescentic island, and a village of 3,000 inhabitants in the centre on sandy land facing its lagoon. The beach in front of the village shows little or no recognizable change, either of growth or loss. Both north and south, loss is clear as determined by beach sandstone and fallen coconut trees. Investigating the geology, we saw many wells and the washing tanks of that village, the latter structures necessary to mosques.[3] They held fresh water, hard from lime and unpleasant for other reasons, but fresh water. Towards the lagoon shore we found certain abandoned wells, which on trial proved to be salt. Tracing these a rough line revealed itself at twenty to thirty years from the top of the beach, landwards of which all wells were fresh and lagoonwards salt.

An abandoned mosque tank straddled the line and one wall had fallen, making visible a line of consolidated sand. Its lower part was at low tide level and all consolidated material was between tide marks. Following this up, we concluded that there was a line of sandstone all along the junction of the salt and fresh waters, a definite hardening and dipping, but layering not well marked. It was more consolidated inland and gradually gave place to loose sand to seaward. I deduce from this that it was formed from inland outwards.

Seeing the "quarrying" at Malé led to inquiries, and we were shown a similar structure in two places to the east of that island on the

[1] Colonel Sewell, director of the Indian Museum, Calcutta, has sent me photographs of this formation at Pamban, Ceylon, where the rock has been exposed.

[2] For maps see Fauna Geogr., Maldives and Laccadives, pp. 3 and 28, 1902.

[3] On our arrival in May, most of these were dry owing to a prolonged drought. The southwest monsoon broke about June 10 and we had intermittent rains up to the end of August, our examination being made in the latter month.

lagoon side. We could not go into Mohammedan house enclosures, but we were assured of its universal occurrence "where the beach is sand."

The suggestion, which I present for testing, will now be obvious. Beach sandstone forms between tide levels where the rain water that falls on the land, becoming supersaturated with calcium carbonate, in sinking through the soil meets the salt water, this causing the precipitation of its lime. The consolidation proceeds hence from inland seawards at such a distance behind the sand beach as the sea water penetrates the same. When the overlying sand of the beach has been washed away, these now exposed strata hold up the destruction long enough to be further consolidated by calcium carbonate from the evaporation of the sea water on their seaward face. This with destruction to seaward may proceed indefinitely, soon entirely hiding the first origin of the beach rock. Meantime, there should be being formed a parallel consolidation line inland from the fresh water dissolved carbonate of calcium. In addition to Minikoi and Malé we found this line, behind well-marked beach sandstone at Turadu, southern Mahlosmadulu, though at the time we did not so explain it — nor examine it from this point of view.

Theoretically, we might have the washing away of a beach going on perpetually. There would be a pause as the fresh water consolidated sandstone was reached; that sandstone would then be converted into the hard beach layers. Meantime, there would be a second fresh water consolidation commencing below the sand at some distance behind. As destruction proceeded, there might be the remains of several lines of beach sandstone behind and parallel to each other, and we found five such at St. Joseph, Amirante.[1] The sand here to landward of the inner layer was only swept away in 1902–03 according to the manager of this island, our examination being made in 1905. Anyhow, I claim that the visible presence of beach sandstone may be taken as a definite criterion of a losing beach, a fact of importance in respect to the theory of the formation of coral islands and of lagoons.

[1] Vide photo in Trans. Linn. Soc. Zoöl., **12**, p. 154, 1908.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. LXXI. No. 2

NOTES ON THE STRUCTURE OF DINICHTHYS AND MACROPETALICHTHYS

By H. C. Stetson

With Seven Plates.

CAMBRIDGE, MASS., U. S. A.:

PRINTED FOR THE MUSEUM

September, 1930

No. 2.— *Notes on the Structure of Dinichthys and Macropetalichthys*

By H. C. Stetson

This paper is intended to illustrate a few details of the anatomy of the Arthrodires, a group made intelligible for the first time by Stensiö's (1925) comprehensive work on Macropetalichthys. Good material is rare enough to warrant the figuring of additional specimens, particularly in the light of his discoveries. The specimens discussed here, all in the Museum of Comparative Zoölogy, are a large individual of *Dinichthys terrelli* long in storage, a cranium of *Macropetalichthys rapheidolabis*, and von Meyer's historic type of *Macropetalichthys hoeninghausi*, which has been further prepared.

My thanks are due Mr. George Nelson, preparator in this museum, for his patience and skill in completing the mount of *Dinichthys terrelli* through many alterations, and for his many useful ideas concerning its anatomy. Dr. P. E. Raymond has been most helpful with advice and criticism.

Mounted Specimen of *Dinichthys terrelli*

The general contour of this specimen (Pl. **1**) is somewhat similar to that of Dean's (1909), but differs from his in important structural details, chiefly by virtue of the fact that it is a good deal more complete. The necessity of restoring so many parts in the latter individual brought about an unsatisfactory arrangement of the plates and left many gaps. Dean himself clearly recognized the difficulties. A comparison of the plates of the two mounts will show clearly where changes have been made. As it is a different species from the one restored by Bryant (1918, Pl. **1**), the shape and arrangement of plates is quite different, particularly in the jaws.

The mount is, of course, not complete, and new anatomical details certainly will be discovered in this curious group. Several odd bones already exist, such as the so-called "pectoral spines," whose position and function is unknown. No ventral shield was found with this specimen, and no restoration was attempted, because at the present time our knowledge as to its exact shape and mode of attachment in this species is indefinite. The sclerotic ring was likewise omitted, and for the same reason. The dorsal and cranial armor and the jaws are, however, unusually complete. As far as possible all existing figures and

restorations were forgotten. The final shape of the fish is the result of following the fit of each of the interlocking plates to its logical conclusion.

Each plate when missing or fragmentary could be fully restored by reference to its mate of the opposite side, with the exception of the posterior ends of the mandibles. These portions were restored from material in the Museum collections, and from figures and measurements given by Hussakof (1906). With all the articulating surfaces, flanges and overlaps complete on one side or the other, the next step, bringing them together, necessitated breaking many of the plates and resetting them. All Cleveland shale material shows a maze of cracks running through the bone and, therefore, much distortion must necessarily be assumed to exist.

After this paper had been completed, I had the privilege of going over, with Dr. Anatol Heintz, the arthrodire material in the American Museum, from which he had constructed a working model. The general shape of the dorsal and cranial shields, which we had arrived at independently, checked remarkably well. Several new plates which he has discovered could be fitted into this mount as it stands. The mandibles are somewhat differently placed, a difference which can be explained by the fact that his material was largely from the smaller *D. intermedius*. The upper jaw elements are also somewhat differently interpreted. His paper will, I believe, be published in the near future.

I have adopted the terminology used by Hussakof, Eastman and others in referring to the various plates as being more familiar, rather than the system of lettering employed by Stensiö, although I do not mean to imply a homology with the bones so named in the higher vertebrates.

It is obvious that the structure of the joint between the cranial shield and the dorsal armor, consisting as it does of a pinion working in a deep groove, permits movement in one plane only. The axis of the joint must, therefore, be horizontal. This sets the antero-dorso-lateral plates with a dip of about 55 degrees. These plates are undistorted, and perfect fits could be obtained with the claviculars in front and with the postero-dorso-laterals in the rear. Dr. Heintz tells me that a small plate is missing from the junction of these three plates. It will be described in his forthcoming paper. This plate is present in Traquair's restoration of Coccosteus (1890). The space to be occupied by the large median dorsal is thus already marked out. That plate had been crushed and the breaks cemented by matrix, and it proved much too flat to meet the articulating surfaces of the antero- and postero-dorso-

laterals. It was rebroken as nearly as possible along the old lines, and then recemented when the correct curvature had been attained.

The cranial shield must articulate with the "clavicular" by a long beveled edge, and with the antero-dorso-lateral by the joint described above. Like the dorso-median, it had been broken in several places, and presented dorsally a concave surface. The shield was rebroken along the old cracks, the joint articulated, and the beveled edge of the cranial shield slipped under the anterior flange of the clavicular. The rest of the cranial shield was modeled to the contour presented by the parts articulating with dorsal shield, and by the structure of the jaws as described below. There is a small dip in the middle portion of the cranial shield which was impossible to remove without serious injury to the pineal plate. Very possibly this slight concavity is natural, as nearly all cranial shields show it.

The general principles of the jaw mechanism are well understood from the work of Hussakof (1906), and especially of Adams (1919). The upturned fangs of the mandibles should be fairly close together when the jaws are open or closed, but not touching. As Adams points out, depressions at the anterior ends of the mandibles show where they were united by strong ligaments. This would place the "rami" of the mandibles well inside the arms of the claviculars. Both the latter plates are undistorted but in neither are the arms complete. The position of the mandibles is also controlled by the elements of the upper jaw and will be taken up below.

In the fork formed by the two arms of the clavicular is a heavy process, or boss (Pl. **4**, fig. 2). Could it have served for the origin of the muscle for opening the mandibles? The insertion would, of course, have been either the inside or the outside of the "ramus" of the mandibular plate. Adams (1919, p. 125–137) figures and describes a small plate attached to the outer face of the tip of the "ramus" of the mandible. He states that the posterior end of this plate "is roughened for the insertion of supporting cartilage or ligament. Very probably it articulated with the inside of the cheek plate or with some other external plate and not with a quadrate." Such a plate appears in Traquair's restoration of Coccosteus (1890). The arrangement is "somewhat as the scapula of mammals is connected with the body." Adams also thinks that the inner face of the "ramus" of the mandible was connected to the inner arm of the clavicular by ligament and fascia. With the triangular plate described above acting as a fulcrum, "raising the head would aid in raising the back part and lowering the front part of the mandible, while lowering the head would close it."

A more simple and effective method would result from the use of the hypothetical muscle attached to the boss described above. A serious objection to Adams's suggestion of attaching the inner face of the mandible to the inner arm of the clavicular is the fact that the two are not close together and are not parallel. The latter bears away from the former throughout its course. If we abolish this method of attachment it is, of course, necessary to have another set of muscles for closing the jaws. These might run from the inner face of the ramus directly to the inner surface of the suborbital. Under this system the mandibles would have considerable motion and would not, as Adams suggests, depend for their opening and closing on a system of levers operated by the muscles of the cranial shield. Although the articulated head shield is proof positive that this part lifted in biting, it need not have opened far. In fact, the articulation between the claviculars and the cranial shield, which plates would have had to pull apart as the latter lifted, is a perfectly normal one. There is nothing to indicate that movement much greater than the normal stretch of ligaments and connective tissue would permit could have taken place.

Stensiö (1925, p. 173), in commenting on restorations exhibited in various American museums, says, "No consideration seems to have been give either to the absence of the paired plate *L* [fig. 24a, p. 174], or to the circumstance that the primordial neurocranium with the olfactory capsules must have extended somewhat forward beyond the anterior margin of the plates *A* (fig. 24B) of the dermal cranial roof." Plate *L* lies laterad to the nostrils in his restoration of Coccosteus — plate *A* is the "preorbital" of American writers. Plate *L* never appears to be an integral part of the cranium in the larger arthrodires. Traquair shows no such plate in his restoration of the cranial shield (1890). I have never succeeded in finding this plate in Coccosteus. The whole anterior border of the orbit appears to be formed by the preorbital or plate *A* as Stensiö calls it, exactly as in Dinichthys. This has, however, only the value of negative evidence. The rostral plate is not scalloped on either side for the nasal opening, but meets the preorbital in a smooth curve. Again the conditions are like Dinichthys, which seems to point to the fact that the nares occupied the same position.

If, however, plate *L* does exist, a possible explanation may be had in the following. Whenever the suborbital plate of *D. terrelli* is found complete, the anterior portion is made up of two divisions, namely, an inferior crescent-shaped flange and, above it, separated by a slot, a heavy process, with a rugose upper surface. Complete suborbital plates are not common. The plate belonging with this specimen is de-

ficient in this respect. There is in the collection, however, an almost complete suborbital plate belonging to a larger individual of the same species (fig. 1). Bryant figures one like it (1918, Pl. 6, fig. 1). This process in life was undoubtedly attached to the anterior edge of the "preorbital," or plate *A* as Stensiö calls it. It bounded the nostril laterally, and served also to hold rigid the anterior end of the suborbital plate, which in turn takes all the thrust of the upper jaw when

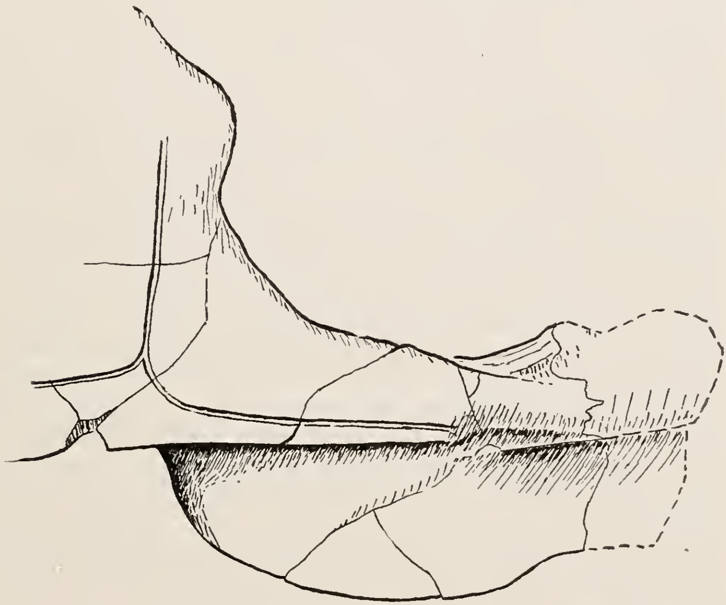

Fig. 1.— *D. terrelli.* Anterior part of large suborbital plate. Parts drawn with broken line are restored. The anterior extension articulates with the edge of the cranial shield, and is separated by a slot from the semicircular flange below. M. C. Z. 1338.

biting. It is possible, therefore, that this is the homologue of Stensiö's plate *L*, which in the later forms became fused to the suborbital plate. Furthermore, this process is separated from the flange beneath by a slot, which runs as far back as the termination of the postorbital canal. The flange, as I have said, extends behind this process, and when these parts are preserved at all, they are usually crushed together and the slot obliterated.

The suborbital can now be placed in such a position that its anterior projecting process can be united to the rugose anterior edge of the pre-

orbital by cartilage or ligaments. The orbit must, of course, be kept round. This brings the upper edge of the suborbital nearly into contact with the cranial shield.

Bryant has restored the suborbital plates in *D. magnificus* (1918, Pl. **1**). The anterior parts resemble those in *D. terrelli* very little. No space is left for the nasal opening. In Dean's restoration the anterior parts of the surborbitals appear to be somewhat imperfect, and are not placed in contact with the anterior edge of the cranial roof. He, likewise, leaves no space for the nasal opening.

Concerning the interrelation of the suborbital plates and the elements of the upper jaw, there has always been considerable uncertainty. The generally accepted view is that based on specimens refigured by Smith Woodward (1922) with the plates in question in what is supposed to be their natural position. In the British Museum specimens, the flange of the suborbital deeply overlaps the postero-supero-gnathal, which in turn is overlapped by the antero-supero-gnathal. A specimen of *D. curtus* figured by Hussakof (1906, fig. 5, p. 112) shows the gnathal elements slightly overlapping the other way, and it is in this position that they are placed in Dean's restoration.

In mounting our specimen we abandoned the orthodox method because the parts would not fit. Material will undoubtedly be described which will settle this question, but it does not seem to me that material now at hand is particularly convincing as to natural association of parts. There is no doubt but that the postero- strongly overlaps the antero-supero-gnathal, as this is the only position in which they would fit together (Pl. **4**, fig. 1). The amount of overlap checks with the cutting edge of the mandible. This arrangement brings the backward projecting processes of the gnathal elements into close proximity, and they were doubtless connected by ligaments or cartilage. In fact, this connection would be the only support possible for the anterior fangs. It seems to be impossible to have the flange of the suborbital overlap the postero-supero-gnathal plate, and at the same time have the fangs in contact with the anterior margin of the cranial shield. The position of the suborbital is fixed. It must articulate with the preorbital, it must continue the rounded contour of the head shield, and the orbit must be kept round. The flange is offset so far behind the rest of the plate (fig. 1) that when placed in contact with the gnathal elements, the latter are displaced far behind the margin of the cranial shield. In addition, the shape of the anterior fangs is such that they do not appear to articulate at all with the cranial shield, even if arbitrarily placed in contact. I have tried this with several specimens with equally poor results.

As there was no possibility of fitting the maxillary plates according to the generally accepted theory, two other methods were adopted, the first of which is probably nothing more than an interesting speculation; the second is more convincing.

If the slot (fig. 1) between the flange and the anterior arm of the suborbital really has functional importance, the process on the upper side of the postero-supero-gnathal could be inserted (Pl. **4**, fig. 1) and the plate would be in correct position to meet the lower jaw. At the same time great rigidity results by bracing this process against the backward projection of the anterior fang, and the rest of the plate against the overhang of the suborbital on top, and against its flange behind (Pl. **2**). This arrangement gives great strength and compactness, but results in the upper gnathal elements projecting beyond the margin of the cranial shield and in an undershot lower jaw.

Let us turn now to the other side of the question. The upper third of the postero-supero-gnathal, including the process, is roughened, and is separated from the lower part by a longitudinal ridge or shoulder (Pl. **4**, fig. 1). This is semicircular in its course, and appears to fit the curved lower surface of the suborbital flange when the flange is lapped over it. The roughened surface would, of course, indicate a cartilaginous attachment between the two. Mounted as in Plate **1**, the lower edge of the suborbital covers the roughened surface, and it butts against the ridge of the postero-supero-gnathal described above, both of which were functionless as mounted in Plate **2**. The upper jaw elements are, therefore, further below the edge of the cranial shield and somewhat under it. This makes the rostrum more prominent in profile, which agrees with the generally accepted notions of Coccosteus.

Whatever method is used in fixing the vertical position of the upper jaw elements, their horizontal position remains unchanged, and this is the only position which counts in fitting the mandibles. With the cutting edges of both jaws engaged, and the upturned flanges close together, the "rami" of the mandibles fall naturally into the forks of the claviculars, and at the same time the extreme tips are overlapped by the lower posterior corner of the suborbital in just the right position to meet the articulation described above.

A certain apparent looseness of structure is inevitable by this method, as the maxillary plates are two or three inches below the edge of the cranial shield. Either new bones will be found in connection with the oral region, or else cartilage played a large part in holding these elements in place.

Olfactory Capsule

Attached to the middle of the under side of the cranium was an oval object, which seems to correspond to those figured by Newberry as eye capsules (1889, Pl. 7, figs. 2, 2a). The larger end was rounded out by a lump of pyrite which came away readily with a little chipping, leaving a cup-shaped depression. As the inside of this elliptical cup was obscured by a thin layer of matrix, it was cleaned with dilute HCl, and then the whole capsule broken longitudinally (Pl. 6, fig. 3). Following the long axis, a single transverse septum crosses the cup from rim to rim. In the bottom of the cup, the upper edge of this septum divides, the branches reuniting near the rim on either side. The trough so formed is filled with matrix. Radiating from this transverse septum to the rim of the cup are a series of close-set, parallel septa, and supporting them is the main body of the capsule. This consists of bone, histologically similar to the other plates, except that this tissue is somewhat more cancellous. This bone is sharply marked off from the septa. A cone of matrix enters the capsule from the basal end and terminates beneath the septa in the center.

If this be compared with the olfactory capsule of a modern elasmobranch, the similarity is striking. The folds meet the same transverse septum at the bottom of the cup, and while they are proportionately longer in the modern instance, it would be remarkable to have such tissue preserved full length in the fossil. The cone of matrix represents the position of the olfactory tract, as in the modern form, terminating beneath the folds. Nervous tissue, of course, would not be preserved.

As mentioned above, Newberry calls these objects eye capsules (1889, p. 146), but from the nature of the evidence there seems little support for this view. He speaks of the depressions in each end as being connected. If this were the case, his specimens were imperfect ones, for the olfactory folds are continuous. The seam in the bottom of the larger cup, described and figured by him, is not a seam, but the large transverse septum. When sectioned, it seems quite evident that the radiating septa cannot belong to the crystalline lens of the eye as he supposed.

Histologic Structure

Although the plates of Dinichthys are commonly supposed to be bone, the only published sections in the literature appear to be those figured by Claypole (1894). Although essentially correct, his figures were not as full or detailed as could be desired. Thin sections were, there-

fore, made from the postero-dorso-lateral and from the ramus of the mandible of *D. terrelli*, and also from the tip and the middle of the mandibular fang of *D. intermedius*, and from some cranial plates of *Coccosteus decipiens* and *Bothriolepis canadensis*.

The sections from the dorsal plate and from the ramus of the jaw would pass anywhere as sections of modern bone (Pl. 5, fig. 1). The Haversian systems are well developed with their concentric lamellae, and with interstitial lamellae filling the spaces between the systems in the less spongy portions. The lacunae with their radiating canaliculi show plainly, as their filling has been stained a very dark brown. Narrow, dark rings are occasionally found around the Haversian canals, which probably indicate resorption lines. The central portion of the plates is spongy, cancellous bone which grows a little denser as the edges are approached, but there can hardly be said to be any indication of periosteal and endosteal lamellae running parallel with the surface. The sections from the postero-dorso-lateral plate showed, on the whole, a more uniformly cancellous type of bone than do those from the ramus of the jaw. In the latter the cancellous bone grades into fairly compact tissue on both the inner and outer faces.

Sections from the mandibular fang present a very interesting condition. Two types of bone are present almost to the tip. A transverse section shows that the inner half is made up of cancellous bone much like that from the ramus of the mandible. About half way through the diameter of the fang there is a fairly sharp line of demarcation, and bone of a very compact type replaces the cancellous tissue (Pl. 5, fig. 2). The Haversian canals are much restricted and the lacunae are more thickly and irregularly scattered. Practically all trace of the concentric lamellae has been lost, in fact the great majority of the canals show no sign of it whatever. There is, however, a differential staining around each canal becoming progressively darker as the canal is approached and also a circular arrangement of the lacunae. This I take to indicate the boundaries of the Haversian lamellae. The actual shearing surface of the fang shows the Haversian canals completely choked off with bone, but the dark, circular spots, described above, persist, indicating the outlines of the Haversian lamellae. The whole cutting surface has taken a very dark stain for the depth of about a millimeter, which in places renders it almost opaque. The lacunae appear to continue to the outer surface. The tip of the fang is composed entirely of this denser tissue, and has taken a very deep stain.

There is no trace of dentine or enamel in the jaws of Dinichthys, whatever may be the case in Coccosteus and the smaller members of

the group. Eastman implies its presence in his descriptions of the dentition of Mylostoma (1906). I have examined most of the specimens referred to by him, and there is no dentine or enamel present. The structure is exactly as in the fang of Dinichthys; cancellous bone overlaid by a dense layer in which the Haversian canals are reduced in size and number, and on the surface are lacking altogether.

Turning now to Coccosteus (Pl. 6, fig. 2) we find that its plates are true bone, but that the histological arrangement is somewhat different from that in Dinichthys. The dorsal plates here are not unlike the flat bones of a higher vertebrate. The inner and outer layers of ground lamellae are well developed, with a cancellous layer of narrow cavities between. The periosteal and endosteal lamellae, as well as the lamellae of the Haversian systems, are differentially stained, and show with remarkable distinctness. The stellate lacunae have a dark filling, and stand out clearly. The outer ground lamellae follow the contours of the surface, rising and falling with the surface ornamentation. A short distance down, in some cases, an alternation takes place, and troughs are found beneath the tubercles of the surface.

No sections were obtained of the so-called "teeth" of this fish, and there are no adequate published figures. They have been referred to in the literature as consisting of dentine of various kinds by Agassiz, Jaekel, Stensiö and others. However, in the absence of further proof than that already brought forward, the suggestion cannot be regarded as established. The "tooth" described by Agassiz, though regarded by him as consisting of dentine, and having a pulp cavity (1844–45, Pl. 3, fig. 2) appears, from the figure, to be constructed of cancellous bone overlaid by a layer of dense bone, exactly as in the other arthrodires. It should be further noted that the denticles on the jaws of other arthrodires do not consist of dentine, but of the modified bone described above. Specimens in the Museum of Comparative Zoölogy which show the "teeth" are all from Nairnshire, and very little organic structure remains in specimens from that locality. The center of the denticle, however, when broken longitudinally, shows a certain fibrous or dendritic structure, brought out by the iron staining common in these specimens. The outer layer is colorless, and shows no trace of structure. It was evidently of denser material, and impervious to the iron-bearing solutions. This might, of course, represent dentine and enamel, but it might equally well be the type of "tooth" found in the other arthrodires. In this case, the dendritic appearance, when broken longitudinally, would be caused by the staining of the Haversian canals and the opaque outer layer would be the dense layer of bone without

Haversian canals, found on the functional surface of other arthrodiran teeth.

The whole question is one of great importance, and should be settled by the illustration of adequate material, as upon it depends the whole status of the arthrodiran jaw. This matter will be further discussed below.

The plates of Bothriolepis (Pl. **6**, fig. 1) show a remarkable histologic resemblance to those of Coccosteus. In the former may be seen the same well-defined inner and outer ground lamellae, the same configuration to the surface contours of these lamellae, and the same cancellous layer between. The lacunae show prominently, as they are filled with a dark stain. So close is the similarity of arrangement, that except for a greater average thickness of the plates of Bothriolepis, it would be impossible to tell them apart.

The Neurocranium of Dinichthys and Macropetalichthys

The inner aspect of the cranial shields of *D. terrelli* (Pl. **3**) and the smaller *D. intermedius* (Mus. Comp. Zoöl. 1477) in the Museum of Comparative Zoölogy, both practically perfect specimens, are the basis of the restoration of the neurocranium (fig. 2). This differs somewhat from Stensiö's restoration (1925, p. 171, fig. 23B) which is derived from the figures and descriptions of Newberry (1889) and Smith Woodward (1922).

Plate **3** shows clearly the "paired lamella" of Woodward. These form the walls of the chondrocranium, and are a good deal higher and more undercut than the photograph indicates, ranging from half an inch to two inches in height. The paired processes arising from the wall behind the orbits are very thick and heavy in *D. terrelli*, and project about three and a half inches. They evidently served for the attachment of muscle or cartilage, as the end is highly rugose. Adams (1919, Pl. **11**) sought a place of attachment for the "depressor capitis" muscle, and this paired process may have furnished it.

Turning now to Stensiö's restorations of the neurocranium of *Macropetalichthys rapheidolabis* (1925, figs. 1, 3, 5), it will be observed that the broad, anterior division of the occipital region is bounded posteriorly by a vertical wall, except for the point of origin of the narrow, posterior division. Laterally, this partition is extended into two curving processes. The rest of the occipital region extending posteriorly is relatively slender, and terminates in two curved horns called the cranio-spinal processes.

In Dinichthys (Pl. 3) we find that the posterior wall of the broad anterior division of the occipital region has approximately the same shape. It consists of two heavy plates of bone (fig. 2, XX,) (the exoccipitals of Woodward, 1922, fig. 4D). Lying between them and somewhat lower, is a forward-projecting tongue of bone, springing from the posterior girder of the cranial shield. It lies dorsad to the posterior narrow divi-

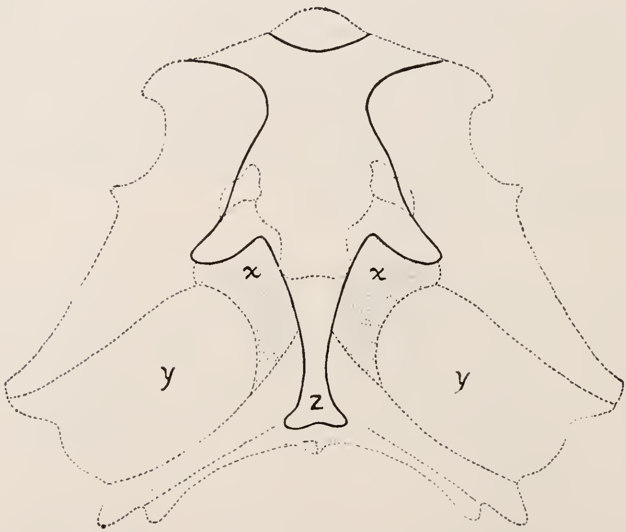

Fig. 2.— *D. terrelli.* Interior of cranial shield drawn from specimen in Plate 3. Heavy line outlines boundaries of chondrocranium, X, X plates bounding posterior wall of anterior division of occipital region, Y, Y possible cavities for branchial apparatus, Z posterior division of occipital region.

sion of the occipital region. This tongue is hollowed at its anterior end. There is no median suture as shown by Newberry and Smith Woodward. The latter considers this marks the end of the brain case (1922, p. 33). Stensiö, however, maintains that the brain case continues to the rear of the cranial shield and shows it thus in his restoration (1925, fig. 23B). In view of his discoveries in Macropetalichthys, this latter position seems to be correct. As can readily be seen in Plate 3, there is a deep, bilobed depression centrally situated at the posterior margin of the cranial shield. The two halves are separated by a low ridge posteriorly, and are bounded by heavy girders of bone which form a triangle. This was occupied, very probably, by the posterior end of the occipital region, and the well-marked cranio-spinal processes (Stensiö,

1925, figs. 1, 3, 5) were lodged in these deep depressions. The posterior wall is very thick and heavy, much heavier proportionately than in *D. intermedius*.

It is very difficult to determine just what was the function of the oblong cavities which occupy each of the lateral extensions of the cranial shield (Pl. 3 and fig. 2, *Y*, *Y*). Smith Woodward has suggested that they housed the branchial apparatus. They appear to be intimately connected with the true neurocranium, as they are bounded on two sides by the posterior extension of its lateral walls, and by the paired bones (fig. 2, *X*, *X*) which mark the posterior wall of the anterior division of the occipital region. On the third side they are bounded by the strong, posterior girder of the cranial shield, and at the rear they are open.

A specimen of *Macropetalichthys rapheidolabis* (Mus. Comp. Zoöl. 1427), from the Onondaga of Lime Rock, New York, can best be interpreted in this connection (Pl. 7). It is really a naturally dissected neurocranium. The dorsal surface is very much weathered, and none of the openings for nerves and blood vessels described by Stensiö are visible, though the sensory canals are still apparent. This portion is removable, and separation takes place along the ventral floor of the neurocranium, and also along the posterior wall of the anterior division of the occipital region, the outline of which is easily seen. Fitting against this wall is a rounded cast, the posterior end of which was formed by the cranio-spinal processes of the posterior division of the occipital region. It is evidently derived from the matrix filling of two paired pouches lying on either side, and the above narrow division of the occipital region. The bone can be seen adhering to the surface of the matrix. Ventrally, this piece has broken along the bony walls of the brain cavity. There are patches of bone adhering to the sides and upper surfaces of this cast, showing that these pouches had a bony covering which was continuous with the rest of the neurocranium. It seems probable, therefore, that they are the homologues of the cavities (fig. 2, *Y*, *Y*) found in Dinichthys, although due to the configuration of the head shield in this instance, they are separated instead of side by side.

In one other respect the preservation in this specimen is remarkable. The anterior end of the notochord is preserved in its entirety (Pl. 6, fig. 4 and Pl. 7). The brain case has been broken transversely, and its bony walls are clearly shown. Below this lies a slender, tapering rod which extends forward nearly to the labyrinth region. The photographs do not show its real termination, as the end of the notochord

has been broken off. The counterpart, however, shows a trough, with fragments of bone adhering, extending forward about 4 mm. beyond the end of the notochord. As Stensiö points out (1925, p. 96), the rod is surrounded by a bone layer of its own, probably fused with the other bony layers of the neurocranium. Stensiö's material was not particularly well preserved in this respect, and the anterior parts of the notochord, that he supposed had become reduced, are thus seen to be present, as in other fishes. A similar case is presented by the sturgeon. In a young individual sagittally sectioned, Parker (1882, Pl. **16**, fig. 2) shows the tapering end of the notochord extending forward beneath the entire length of the hind brain. This is quite the usual condition in the embryos of higher vertebrates.

Macropetalichthys hoeninghausi (v. Meyer)

The type of this species (fig. 3), originally described by von Meyer (1855, Pl. **15**) as *Physichthys hoeninghausii,* is in the Museum of Comparative Zoölogy, no. 5174. It is possible that this is a synonym of *M. agassizi* (v. Meyer), but I have kept the above name for convenience in referring to this particular specimen. In 1907, Henning described another individual as *M. pelmensis*. Comparison of his figures with the ones included here make it probable that his species is really *M. hoeninghausi*.

The parts ventral to the cranio-spinal processes are missing, as in the other macropetalichthyids. Stensiö (1925, p. 95) suggests that this part was probably cartilaginous, and, therefore, not preserved. The posterior division of the occipital region is leaf-shaped, widening rapidly as it goes forward. It is relatively much larger than in any other macropetalichthyids. The haemal groove is deep, and in the bottom is the prominent notochordal ridge. On either side of this ridge is a groove, terminating in a small opening at the base of the occipital region. This appears to correspond to what Stensiö (1925, fig. 18, p. 155) calls the canals for the "radix aortae."

The cranio-spinal processes are not visible in this specimen, as they are covered by two heavy, bony plates separated by a median suture, which descends from the cranial shield. They block off the whole posterior part of the occipital region, except the haemal grooves described above, the outlet for the notochord, and spinal chord. These identical plates are shown in Henning's figure of *M. pelmensis* and were somewhat wrongly interpreted, as Stensiö (1925, p. 152) points out. The funnel-shaped openings, interpreted by Eastman (1908) as openings

for the endolymphatic ducts, on further dissection prove to be an integral part of the paired plates described above. They are concave outwardly, and appear to fill the angle between the vertical paired plates and the dermal cranial roof. The concavity is filled with a very spongy, cancellous bone. Eastman appears to have been somewhat mistaken in his interpretation of the neurocranium (Stensiö, 1925, p. 152).

The anterior, broad division is broken off short midway, very much as von Meyer figured it. The prominent notochordal ridge seems to

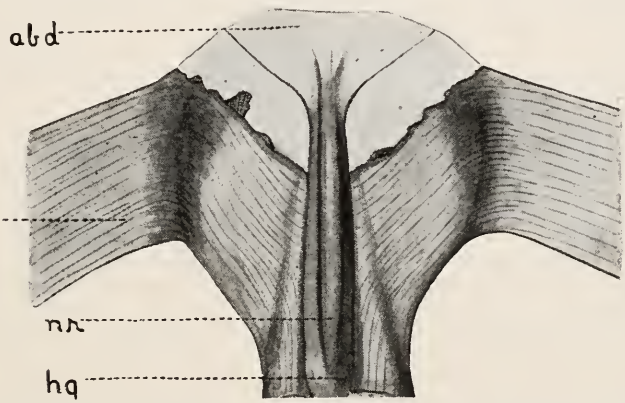

FIG. 3.— *Macropetalichthys hoeninghausi.* Restoration of posterior part of the chondrocranium ventral view. *a b d* anterior broad division of occipital region, *l p* lateral process of broad anterior division of occipital region, *n r* notochordal ridge, *h g* haemal groove.

reach about the same point as in *M. rapheidolabis.* Further dissection has revealed the presence of a large postero-lateral process on either side of the occipital region. This is present in other macropetalichthyids, but is unusually large in this case.

Von Meyer's figure of the dorsal surface is excellent. The ornamentation, and the course of the sutures and sensory canals as far as they can be observed, correspond closely to *M. pelmensis.*

It is extremely unlikely that further dissection would reveal more of the neurocranium. The broken anterior edge of the specimen has been polished, and there is no trace of any bone layer extending as far as this. Furthermore, sections of crinoid stems are thickly scattered through the matrix filling of the specimen, showing that a breaking down of most of the bone layers must have occurred. In view of these facts, and especially as the specimen is an historic type, further dissection at this time seems inadvisable.

Homologies of the Jaw

The arthrodiran jaw has always been a fruitful source of discussion. Dean, Hussakof and Adams are of the opinion that it is not the homologue of the gnathostome jaw, while another group, notably Smith Woodward, Stensiö and Jaekel, are of the opinion that it is.

It seems surprising that in all this discussion no attention has been paid to the fact that whatever the origin, here is an animal actually using bare bone for a biting surface. That the cutting edge itself is bone cannot be doubted, and that it was bare and had no enamel or dentine layer, or no horny sheath is equally evident. Lines of wear and polished surfaces on the bones themselves are very apparent, and have frequently been mentioned in the literature.

Dr. Thomas Barbour has called to my attention a case closely parallel to this, presented by *Babina holsti* (Boulenger) and *B. subaspera* (Barbour), two species of dagger frogs from the Loo Choo Islands. Van Denburgh (1912, p. 197) figures and describes the hand of one of them, and finds that the first metacarpal is transformed into a sharp, curving, thumb-like spur. This is used as a weapon of attack and defense, and is capable of being driven home with great force. It is perhaps employed in shucking the crabs, on which the frogs feed, out of their shells. When not in use, this spike is retracted into a fleshy sheath. Specimens in the Museum of Comparative Zoölogy have been examined, and the spike is bare bone exactly as Van Denburgh described it, and no horny covering of any sort is present. Van Denburgh also states that the spurs do not become firm enough for use until the frog is of considerable size. The condition of a young arthrodire's jaw, and its consequent feeding habits, opens an amusing field of speculation. As in the frog, the cutting edge must have been fully developed before it could be effectively used. Periosteum, of course, could not exist on a biting surface.

Antlers might be considered a somewhat similar case, but not exactly homologous, in that they are shed every year.

The question of the homologies of the arthrodiran jaw partly depends on the status of the so-called "teeth" which some of them display. If these "teeth" were true dentine and enamel, the evidence would be fairly strong for jaws of the gnathostome type. If not, though not precluding the possibility of gnathostome origin, the weight of the evidence is all on the side of their being modified dermal plates.

Coccosteus is the most favorable case in support of the former theory. There are well-developed denticles both at the symphysis, and along

the oral margin of the mandible. This genus occurs in the lower Old Red, and, therefore, should be a primitive form, in so far as a fish like an arthrodire can be primitive. True teeth, if they were ever present, might be expected here in preference to any other form now known. From the evidence so far presented, however, as stated during the discussion on histologic structure, it can by no means be taken as a proved fact that these denticles of Coccosteus are true teeth. Dentine and enamel are not present in any of the larger forms now known: the denticles and cutting surfaces are all true bone. Adams (1919) reviews the case exceeding well for the modified dermal plate theory, and it is unnecessary to restate the argument here.

Three important attempts have been made to homologize the oral region of an arthrodire with that of a true gnathostome. Eastman (1906), in describing *Dinomylostoma beecheri* from the mandibles, finds an articular cartilage, probable traces of the position of Meckel's cartilage, and calls the posterior end of the mandibles splenials, as he does in other arthrodires. The two latter points are sheerest hypothesis. As for the "articular" cartilage, it is obvious that some cartilage attachment is necessary for attachment of a jaw of this type, but this does not make it the cartilagenous prototype of the true articular of higher vertebrates. Adams (1919, p. 127) discusses this case at some length.

Jaekel (1907) has dissected the mandible of Pholidosteus, and finds another complete homology with the gnathostome mandible. His figures are inadequate, and it is impossible to form an opinion on such an important matter without seeing the original material. Stensiö (1925), having seen the material, entirely substantiates Jaekel in his interpretation. Stensiö earlier points out, however, that homologies of the skull bones between Arthrodira and Teleostomi probably are invalid. Why should not this apply equally well to the jaws, which have been even more modified, and where there are even fewer similarities between the parts to be compared?

Smith Woodward (1922) has observed a bone which he regards as the pterygoid, but adds that its relationships are not quite clear. This is probably the most convincing piece of evidence yet presented in favor of gnathostome origin. It should be remembered, however, that there are probably many small bones in connection with the skull which are not known from material now described, but which may throw further light on this problem.

Relationships

The resemblance between the Arthrodira and the Antiarcha has long been commented upon. An additional feature which deserves notice is the striking similarity between the jaw elements of the two forms (Patten, 1912, p. 373, fig. 254). The mandibles have the same heavy external part with the biting edge, and the slender "ramus." The mandibles of Diplognathus offer a close comparison. The shape of the plates in the upper jaw of Dinichthys is likewise very similar. Patten maintains that these jaws function after the manner of Arthropods. An up and down biting motion is, however, not impossible. Here again is another animal whose "teeth" are bare bone. A highly specialized characteristic of this sort should have special weight in a scheme of relationships.

Stensiö, in summarizing his results, is led to the conclusion that the arthrodires are close relatives of the elasmobranchs. Discounting the fact (1925, p. 145) that "the restoration of the brain given in text figs. 12 and 13 is based chiefly on conditions in Heptanchus, and is, of course. to a large extent rather arbitrary," nevertheless, certain points of similarity do exist between the brain of elasmobranch and arthrodire. A brief summary is given by Stensiö on page 187. We could form a clearer estimate of the value of such criteria if we had some of the early Devonian ganoid brains for comparison. For in certain other morphological details the early ganoids also resemble elasmobranchs closely. Relationship is, of course, a matter of degree, and so far the evidence presented does not seem to warrant a closer relationship between elasmobranch and arthrodire than that which exists between elasmobranch and ganoid, or between ganoid and teleost.

Another point which is becoming more and more important, as the study of the early fishes progresses, is the question of bone. It is an exceedingly ancient tissue. So far, it is known as early as the middle Ordovician, from the "bone-bed" at Canyon City, Colorado. Did the common ancestor of the fishes possess it, or did it arise separately in the different groups? Stensiö holds strongly to the first theory and maintains that the ancestral chordate had a complete exoskeleton of bone. Both ostracoderms and arthrodires, accordingly, present a series in which the bony exoskeleton has become progressively reduced. This, however, does not appear to be entirely substantiated in the case of the arthrodires. The same bones are present in Dinichthys that are found in Coccosteus. They are somewhat different in shape, and present a more continuous buckler in the latter case, but this does not

seem to indicate a fundamental tendency towards reduction. The higher animals show a reduction in the number of skull elements, but as this reduction is accompanied by fusion with other dermal and cartilage bones, often a more complete bony case is attained. In the ostracoderms likewise the theory is open to question. Therefore, unless homologies of individual dermal bones of the skull are made, the theory has little significance, as the rest of the dermal skeleton lends itself better to an exactly opposite interpretation. Furthermore, a distinction must be made between dermal and cartilage bone, as the latter certainly shows no tendency towards reduction. Under this theory, sharks would have advanced farther than any other vertebrate.

It is difficult to see why it is necessary to postulate so universal a tendency to explain conditions found in these early fishes. As in modern groups of animals, some members have heavy exoskeletons and some have light, but no progressive tendency is manifest. A long line of unbroken descent would be essential for this theory, and certainly this is far from the case in the ostracoderms, a group not closely related. Heavily armoured and lightly armoured forms are well mixed in point of time. The common ancestor of these early fishes undoubtedly possessed bone, since this tissue occurs so early, but the evidence does not necessarily postulate a heavily armoured form, or vice versa.

If the arthrodires are closely related to the Antiarcha, as the histologic structure of the exoskeleton, the shape of the jaws, and the articulated head shield would seem to indicate, both must be gnathostomes, or both must have jaws derived from modified dermal plates. It is unlikely that the latter are true gnathostomes.

As our knowledge of ostracoderms progresses, it has become apparent that an animal may be a chordate and still not have jaws derived from the first visceral arch. The jaws so far described from this group are all different, and all are modified dermal plates. Most of these individuals unhappily appear to be specialized end products of lines which lead nowhere. The main gnathostome stem is almost as obscure as ever. From the evidence now at hand, the arthrodires can be nothing but a larger and more fishlike experiment in the great group of Agnatha.

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EXPLANATION OF PLATES

PLATE 1

PLATE 1

Dinichthys terrelli. In this mount the flange of the suborbital overlaps the postero-supero-gnathal. See Plate **4**. The "ramus" of the mandible should be raised about four inches. The angle between the two dorso-lateral plates and the clavicular should probably be filled in by another plate. Length 47 inches.

Photograph by George Nelson

PLATE 2

PLATE **2**

Dinichthys terrelli. Mounted specimen, frontal view. The mounting of the upper jaw elements is the reverse of Plate **1** in that the postero-supero-gnathal fits into the slot of the suborbital, and overlaps the flange. The nasal capsules should be higher up under the cranial roof. Maximum width 37 inches.

Photograph by George Nelson

PLATE **3**

PLATE **3**

Dinichthys terrelli. Underside of cranium of mounted specimen. See text figure 2. Maximum breadth 27 inches.

Photograph by George Nelson

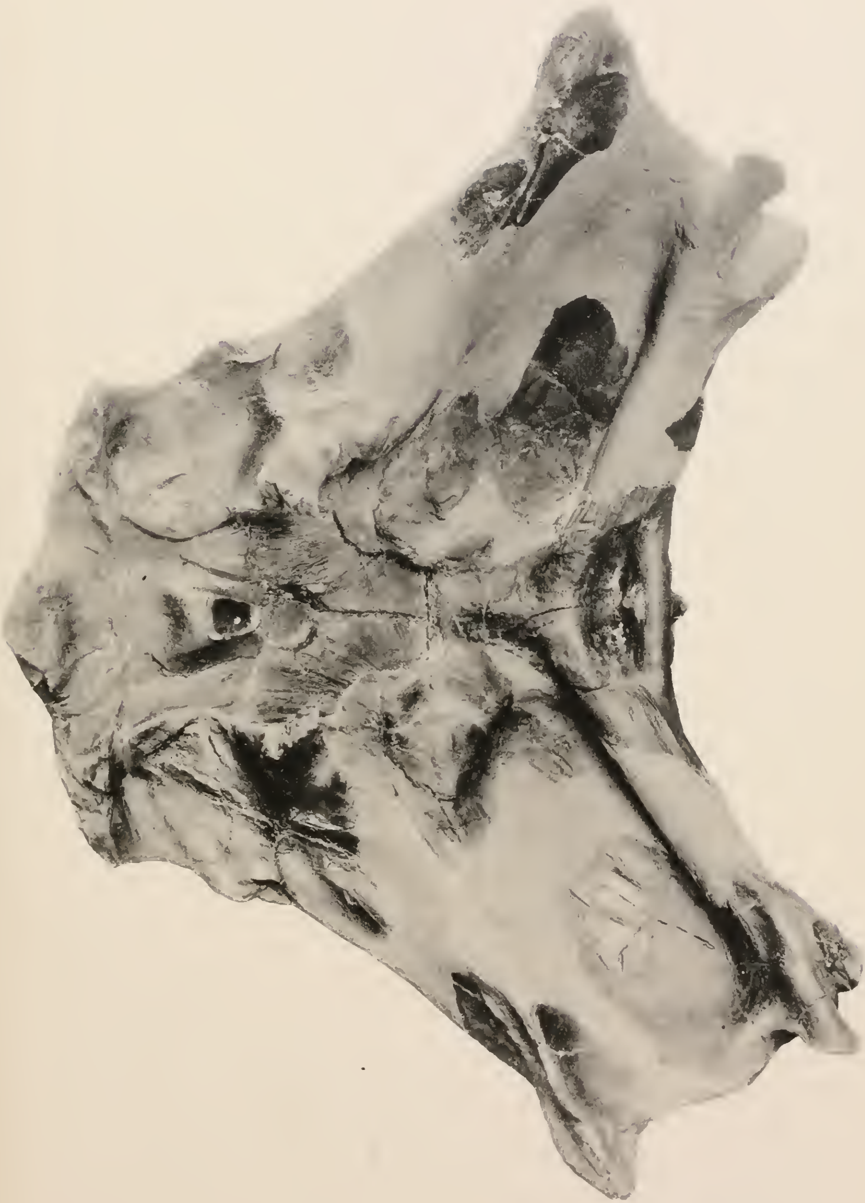

PLATE 4

PLATE **4**

Fig. 1. *Dinichthys terrelli.* Upper gnathal elements from right side. Note the overlap of the postero- on the antero-gnathal. The shoulder or ridge, demarking the rugose upper half of the postero-gnathal, serves as the articulating surface for the suborbital flange as mounted in Plate **1**. Length 9½ inches.

Fig. 2. *Dinichthys terrelli.* Right "clavicular." Note the boss above the junction of the two arms suggesting the origin of the muscle for opening the mandible.

Photographs by George Nelson

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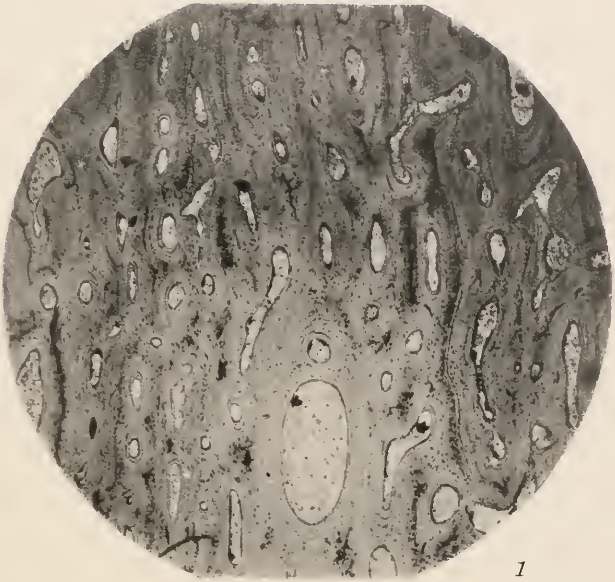
PLATE 5

PLATE 5

Fig. 1. *Dinichthys terrelli.* Transverse section from "ramus" of mandible. Note the well-developed Haversian systems with concentric lamellae and lacunae. × 30.

Fig. 2. *Dinichthys intermedius.* Transverse section near shearing surface of mandibular fang. The bone is very compact with consequent reduction of the Haversian canals. The lamination may be followed by the circular course of the lacunae. × 90.



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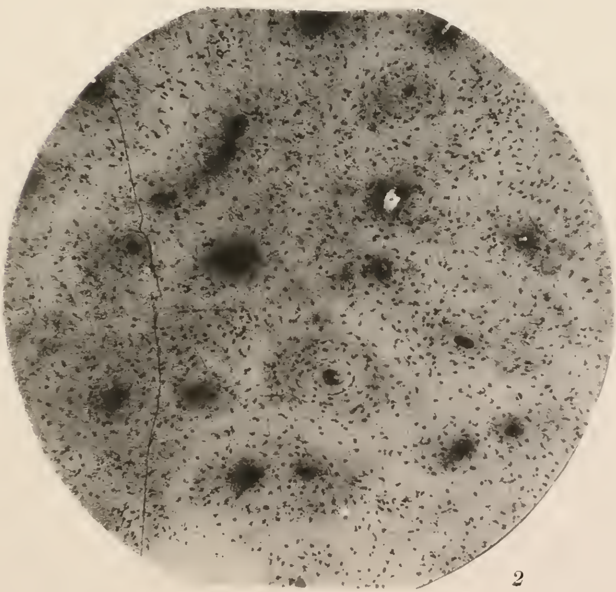

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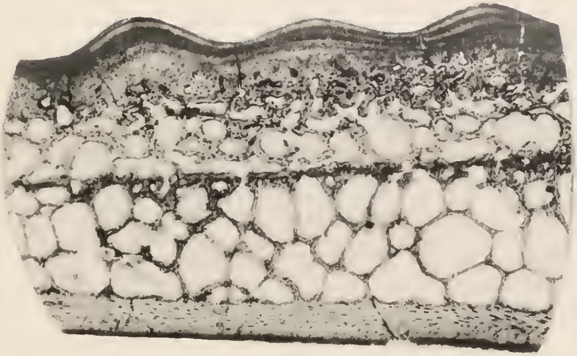
PLATE 6

Fig. 1. *Bothriolepis canadensis.* Section of dorsal shield. Note lamination and lacunae of outer and inner bone layers, with possible marrow cavities between. × 30.

Fig. 2. *Coccosteus decipiens.* Section of dorsal shield. Note similarity to Bothriolepis. × 30.

Fig. 3. *Dinichthys terrelli.* Nasal capsule longitudinally broken. Note the olfactory folds held in the bony cup, with matrix filling the space once occupied by the olfactory tract. × $\frac{1}{5}$.

Fig. 4. *Macropetalichthys rapheidolabis.* Anterior extension of notochord. See Plate **7**. × 3.



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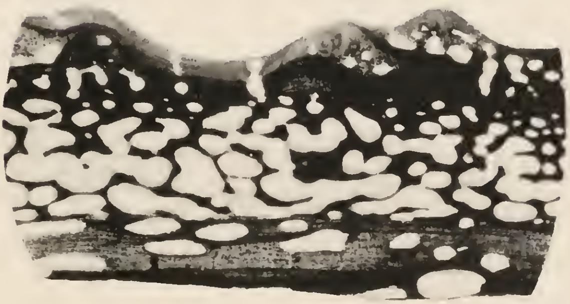

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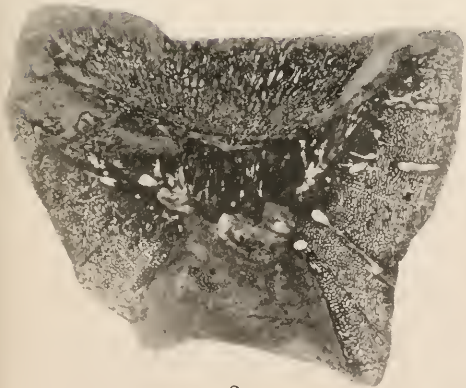

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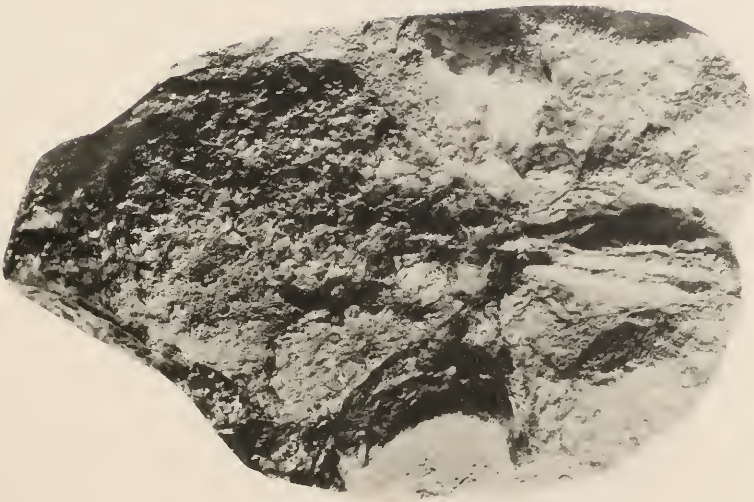
PLATE 7

PLATE 7

Macropetalichthys rapheidolabis. Ventral surface of chondrocranium naturally dissected; part and counterpart. The broad and narrow divisions of the chondrocranium show very well. In the former may be seen the anterior extension of the notochord (see Plate **6**, fig. 4), and in the latter the bony wall of the neural canal, broken lengthwise. $\times \frac{7}{10}$.



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Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. LXXI. No. 3

THE HOLOTHURIANS OF THE WESTERN PART OF THE ATLANTIC OCEAN

By Elisabeth Deichmann

With Twenty-four Plates

CAMBRIDGE, MASS., U. S. A.:

PRINTED FOR THE MUSEUM

November, 1930

No. 3.— *The Holothurians of the Western Part of the Atlantic Ocean.*[1]

By Elisabeth Deichmann

Introduction

This paper is a monograph of the Holothurians of the western part of the Atlantic Ocean, from the coast of Brazil to Cape Cod, including Bermuda.

The Holothurian fauna of this region has never been worked out. The first paper about this group of Echinoderms we owe to Lesueur, 1823. Some of the species which he described from St. Bartholomew are still recognized. Subsequently a number of short notes were published, unfortunately without any figures but often with very characteristic descriptions (Stimpson, Ayres). In 1867 Selenka's classical monograph on the Holothurians of the world was published. His paper contains a number of West Indian species and most of his descriptions are accompanied by figures. Since then a number of small papers have been published, dealing with the local fauna of various places (Bermuda, Woods Hole, etc.), exclusively littoral forms. The deep-sea forms of the American waters were treated for the first time in 1885 when Verrill published his account of the deep-sea dredgings of the "Albatross," a paper which seems to have been entirely forgotten. The following year Théel's "Blake" and "Challenger" reports came out.

A study of the older literature shows clearly that the number of synonyms and wrong identifications has become very large, and only a very careful study of the collections could bring the Holothurians into such order that conclusions could be reached regarding the composition of the western Atlantic fauna.

The following paper is based entirely upon museum material, and includes practically all the material available from this region. It is primarily a revision of the unique collection in the Museum of Comparative Zoölogy, which contains most of Selenka's types, and an examination of the very large collections in the United States National Museum. Besides a very large number of littoral forms, the National Museum collections contain all the undetermined Holothurians from the deep-sea dredgings of the "Albatross" in 1884–85. The collections

[1] By vote of the Faculty of the Museum, this paper is published with the aid of the Alexander Agassiz Fund for the publication of "Albatross Results," since most of the material studied was secured during the explorations of that vessel.

in the British and Copenhagen Museums have been studied and also the specimens at the University of Iowa, collected by the Barbados-Antigua Expedition. Only a few specimens of littoral forms in certain museums in Germany and Holland have not been examined.

From these studies it appears that the fauna of the region under consideration contains about 60 littoral species and about half as many deep-sea and continental forms. While only a few additions to the littoral fauna can be expected, it is probable that everything known from the deeper water of the eastern part of the Atlantic Ocean will be found to occur also in American waters, and the keys and references have therefore been made to include all Atlantic deep-sea Holothurians. The order Apoda has been treated rather briefly because the members of that group have recently been worked out by H. L. Clark, according to modern principles, with numerous figures, and therefore little had to be added. The Apoda are included in the present paper to make it complete, and because it is necessary to consider all orders, when we try to discuss the geographical distribution and the origin of the West Indian fauna.

The Holothurians of the region treated here include, besides the widespread deep-sea species, mostly tropical and subtropical forms; the latter reach very far north on account of the Gulf Stream, and it is difficult to draw a line between the two groups. A few arctic forms are included because they extend so far south that they enter the region which is otherwise occupied by subtropical forms; they are dealt with quite briefly, and in the discussion of the Holothurian fauna of this region as a whole, they are not included.

The present paper is primarily a taxonomic paper with descriptions of the anatomy, as far as the condition of the specimens has permitted, and a detailed study of the important spicules of the integument; these have in most cases been figured, except in the orders Elasipoda and Apoda. The spicules of the species in these groups have recently been figured by Hérouard, Perrier and Clark.

The often considerable changes which the spicules undergo during growth have been studied whenever it has been possible. Most of the material was, however, collected at a time when large specimens alone were preserved, and the growth series which have been available are therefore often very incomplete. It has nevertheless been possible in many cases to work out the course of development which the spicules probably take, either by becoming more complicated or more reduced, and many errors which have arisen from examination and description of immature or senile specimens have thus been corrected.

Except for the deep-sea order Elasipoda which Hérouard (1923) and Ekman (1925) recently have studied, and the order Apoda which H. L. Clark has treated (1908), it must be said that the detailed systematic arrangement of the remaining orders, the Aspidochirota, Dendrochirota and Molpadonia, is, as yet, very unsatisfactorily worked out.

The fauna which has been studied here is not rich enough to enable us to lay a foundation for a better systematic arrangement. But it contains so many different types that an idea may be gained as to what lines the systematic arrangement will probably follow, when equal value is given to the general anatomical features and the spicules. Keys have, therefore, been prepared, in most cases, so that species which seem to be nearly allied have been placed near each other, and consequently in some cases characters not absolutely necessary for the rapid determination of a species are mentioned in the keys.

In other Echinoderms the study of the larvae has proved to be of value in reaching a natural systematic arrangement (Mortensen, 1901). The larvae of the Holothurians, however, are apparently of a very uniform and simple type, so that it is probable they will prove of less help. They are at present very unsatisfactorily known; very few larvae have been reared and practically no comparison of the different types has been undertaken. A careful study of larval forms may therefore prove to be of some value, not only from a systematic point of view but also for understanding problems of distribution.

Very few biological notes have been included in the present paper, and these are mostly as given by W. K. Fisher and H. L. Clark. A further study of these animals in life will undoubtedly be of great interest, as it seems as if most of them are closely limited to certain habitats, and their choice of living places corresponds well with their anatomy and armature of spicules.

The results obtained may be briefly summarized as follows:

1. The West Indian Seas, including the eastern coast of the United States and the waters around Bermuda, have a rather rich fauna of littoral holothurians, namely about 20 tropical Aspidochirota, 20 Dendrochirota, partly tropical, partly subtropical, and a few Apoda. There is also a typical deep-sea fauna of Elasipoda, Aspidochirota (Synallactidae) and a few Molpadonia and Dendrochirota; about 30 species actually are known, but more are undoubtedly present.

2. A few arctic or boreal forms known also from the northern part of Europe and Greenland are intermingled with the subtropical fauna and reach as far south as does the cold water, or about to Cape Cod.

Records of boreal forms further south than this have proved to be incorrect.

3. Most of the Aspidochirota belonging to the littoral fauna are very uniformly spread over the tropical region (Gulf of Mexico, Caribbean Sea, Bermuda). They have apparently originated from the Pacific fauna. The relation to the eastern Atlantic fauna is very small. It may be that the few tropical forms which occur in both the western and eastern part of the Atlantic Ocean, as for instance *Holothuria mexicana*, were originally West Indian.

4. Many of the West Indian species show small but distinct differences from the Pacific forms; most of them have a parallel form in the Pacific Ocean.

5. The Dendrochirota and Apoda, which range from littoral to sublittoral, seem all to be endemic and have apparently no parallel forms in the Pacific Ocean. A few forms seem to be represented by closely related forms in the eastern Atlantic.

6. The west Atlantic deep-sea fauna of Holothurians is entirely Atlantic in its composition. It has nothing in common with the fauna of the Gulf of Panama (as one might naturally expect). The Gulf of Mexico and the Caribbean Sea are poor in regard to deep-sea forms and resemble thus a typical "Mediterranean Sea." The deep-sea forms are found most abundantly on the outer Atlantic side of the Antilles and along the coast of New England.

7. The deep-sea forms are generally found in lesser depth in the West Indies than in the eastern part of the Atlantic Ocean.

8. The distribution of the north Atlantic deep-sea forms seems to cover the area which is influenced by the Gulf Stream; the greater part of the Atlantic Ocean more than a few hundred miles from the mainland or the oceanic islands is apparently devoid of Holothurians (a few species have been collected on the Dolphin Ridge).

9. The distribution of the Atlantic deep-sea Holothurians, as we know it, from the explorations of the "Talisman," "Princess Alice," "Albatross," "Blake" and "Ingolf," argues against the theory of Théel (1882) that the deep-sea forms have direct development and spread over the sea bottom only by slowly creeping. Some of them apparently spread by means of swimming or drifting larvae, as has been observed in the case of *Scotoanassa translucida*, by Hérouard (1923, p. 88). Most likely many of them float at some depth, so that they never are taken in surface nets.

List of Holothurians at Present Known from the Western Part of the Atlantic Ocean

Order Aspidochirota
- Family Holothuriidae
  - Genus Holothuria
    - H. arenicola Semper
    - H. cubana Ludwig
    - H. densipedes Clark
    - H. floridana Pourtalès
    - H. glaberrima Selenka
    - H. grisea Selenka
    - H. impatiens (Forskål)
    - H. mexicana Ludwig
    - H. imperator sp. nov.
    - H. occidentalis Ludwig
    - H. parvula (Selenka)
    - H. princeps Selenka
    - H. pseudofossor sp. nov.
    - H. surinamensis Ludwig
  - Genus Actinopyga
    - A. agassizi (Selenka)
  - Genus Stichopus
    - S. badionotus Selenka
    - S. macroparenthesis Clark
  - Genus Astichopus
    - A. multifidus (Sluiter)
- Family Synallactidae
  - Genus Pseudostichopus
    - P. depressus Hérouard
    - P. atlanticus Perrier
    - P. occultatus v. Marenzeller
    - P. villosus Théel
  - Genus Mesothuria Théel
    - M. gargantua sp. nov.
    - M. intestinalis (Ascanius and Rathke)
    - M. maroccana Perrier
    - M. rugosa Hérouard
  - Genus Bathyplotes
    - B. natans (Sars)
    - B. pourtalesi (Théel)

Genus Pelopatides
Pelopatides gigantea (Verrill)
Genus Amphigymnas
A. bahamensis sp. nov.
Genus Zygothuria
Z. lactea Théel
Z. sp.
Order Elasipoda
Family Deimatidae
Genus Deima
Deima blakei Théel
Family Psychropotidae
Genus Benthodytes
B. kerhervei (Hérouard)
B. lingua Perrier
B. typica Théel
Genus Euphronides
E. auriculata Verrill
E. violacea Perrier
E. talismani Perrier
Order Dendrochirota
Genus Phyllophorus
P. dobsoni Bell
P. destichada sp. nov.
P. communis (Forbes)
P. conchilegum (Pourtalès)
P. occidentalis Ludwig
P. parvus (Ludwig)
P. pellucidum (Fleming)
P. seguroensis sp. nov.
P. tritus (Sluiter)
Genus Echinocucumis
E. hispida (Barrett)
E. hispida var. atypica var. nov.
Genus Cucumaria
C. argillacea (Sluiter)
C. calcigera (Stimpson)
C. frondosa (Gunnerus)
C. nina sp. nov.
C. parassimilis sp. nov.
C. pulcherrima (Ayres)

Genus Thyone
- T. belli Ludwig
- T. briareus (Lesueur)
- T. cognita (Lampert)
- T. fusus (O. F. Müller)
- T. gemmata Pourtalès
- T. micropunctata Sluiter
- T. pervicax Théel
- T. pseudofusus sp. nov.
- T. sabanillensis sp. nov.
- T. scabra Verrill
- T. solida sp. nov.
- T. surinamensis Semper
- T. suspecta Ludwig
- T. unisemita Stimpson

Genus Pentacta
- P. pygmaeus Théel

Genus Psolus
- P. complicatus sp. nov.
- P. fabricii (Düben and Koren)
- P. operculatus Pourtalès
- P. phantapus (Strüssenfeldt)
- P. pourtalèsi Théel
- P. tuberculosus Théel
- P. tuberculosus var. destituta var. nov.

Genus Thyonepsolus
- T. braziliensis (Théel)

Order Molpadonia

Family Molpadiidae

Genus Molpadia
- M. agassizi (Théel)
- M. blakei (Théel)
- M. musculus (Risso)
- M. oölitica (Verrill)
- M. parva (Théel)

Genus Caudina
- C. albicans Théel
- C. arenata Gould
- C. obesacauda Clark

Genus Gephyrothuria
- G. glauca (Clark)

Order Apoda
- Family Synaptidae
  - Subfamily Synaptinae
    - Genus Euapta
      - E. lappa (J. Müller)
    - Genus Synaptula
      - S. hydriformis (Lesueur)
    - Genus Leptosynapta
      - L. acanthia Clark
      - L. circopatina Clark
      - L. crassipatina Clark
      - L. inhaerens (O. F. Müller)
      - L. multigranulata Clark
      - L. multipora Clark
      - L. parvipatina Clark
    - Genus Protankyra
      - P. abyssicola Théel
      - P. benedeni Ludwig
      - P. brychia Verrill
  - Subfamily Chiridotinae
    - Genus Chiridota
      - C. laevis (Fabricius)
      - C. pelorica sp. nov.
      - C. rotifera Pourtalès

HOLOTHURIOIDEA

Key to the Orders

1. Without pedicels or papillae, not even anal papillae Order V. Apoda, p. 203
1. With either pedicels or papillae, or both, usually in great numbers, but in some cases only small anal papillae 2
2. Tentacles dendroid; retractors present; respiratory trees present; no tentacle ampullae; no rete mirabile; genital organs in two tufts.
Order III. Dendrochirota, p. 138
2. Tentacles peltate or peltato-digitate 3
3. Respiratory trees absent; no retractors; no tentacle ampullae; no rete mirabile; genital organs in two tufts; deep sea forms.
Order II. Elasipoda, p. 113
3. Respiratory trees present 4
4. Appendages numerous; tentacles peltate . . Order I. Aspidochirota, p. 51
4. Appendages absent, except as anal papillae; tentacles digitate.
Order IV. Molpadonia, p. 193

ORDER I

ASPIDOCHIROTA Grube 1840

Diagnosis, after Ekman, 1925, p. 535.— Appendages present; tentacles peltate; no oral retractors present; respiratory trees developed; the mesentery belonging to the third loop of the intestine runs in the right ventral interradius. Deposits, when present, either derived from pointed rods, or from primary crosses, and in the latter case present as tables or derivatives of tables.

The order contains 3 families, namely, Holothuriidae Ludwig, Stichopodidae Haeckel and Synallactidae Ludwig.

Key to the Families

1. Tentacle ampullae absent; in most cases no rete mirabile is present; respiratory trees free .... III. Fam. Synallactidae Ludwig
1. Tentacle ampullae present; rete mirabile well developed; left respiratory tree entangled in rete mirabile 2
2. Genital organs in two tufts .... II. Fam. Stichopodidae Haeckel
2. Genital organs in one tuft on left side of dorsal mesentery.
I. Fam. Holothuriidae Ludwig

HOLOTHURIIDAE Ludwig 1894

Diagnosis, after Ekman, 1925, p. 586.— Aspidochirote Holothurians with tentacle ampullae; genital organs present only on left side of dorsal mesentery; head of madreporic canal separated from body wall.

Three genera are recognized at present, namely *Holothuria* Linnaeus, *Actinopyga* Bronn and *Labidodemas* Selenka. The last genus is known only from the Pacific Ocean, and will probably be united with the first which, on the other hand, will undoubtedly become divided into a number of smaller groups, with the rank of genera or subgenera.

Key to the Atlantic genera

1. Anus not surrounded by 5 large conspicuous calcified anal teeth; mesentery not with secondary attachments to the body wall; deposits of various kinds, as tables, buttons, grains, rosettes, rods...... *Holothuria* Linnaeus
1. Anus surrounded by 5 large conspicuous calcified anal teeth; mesentery with secondary attachments to the body wall; deposits as grains or rosettes or short rods, at least in full grown specimens. *Actinopyga* Bronn

Holothuria Linnaeus 1758

Holothuria Linnaeus, Systema Naturae, 10th ed., 1758.

Diagnosis, after Théel, 1886, p. 202—Tentacles 20, exceptionally more or less; ambulacral appendages pedicels alone, papillae alone, or both pedicels and papillae, the papillae placed on the dorsal surface, the pedicels on the ventral. These ventral pedicels are seldom arranged in longitudinal series. Anus devoid of calcareous teeth, but sometimes stellate. C-shaped deposits absent.

Key to the species of the genus Holothuria occurring in the Western Atlantic

The species are, in the present key, arranged in as natural groups as possible. The calcareous deposits have, in most cases, been treated first, and the anatomical features which often are difficult or impossible to study have been placed in the second line.

1. Deposits, rosettes or perforated plates and tables................Key III
1. Deposits, elongate buttons or rods, usually also tables..................2
2. Deposits knobbed buttons and tables..........................Key I
2. Deposits smooth buttons, or rods, usually also tables..............Key II

Key I

Skin rigid, filled with deposits; relatively thin tentacles; small burrowing forms, often occurring in deeper water, below tide mark.

1. Buttons regular, complete......................................2

1. Buttons irregular, often incomplete 3
2. Tables very complicated, developed as reticulated spheres; buttons strongly knobbed, middle bar of buttons not projecting beyond end of deposit. *H. cubana* Ludwig
2. Tables not complicated, with knobbed margin; buttons with undulated surface; middle bar of buttons often projecting beyond end of deposits. *H. pseudofossor* n. sp.
3. Gigantic tables with long, conical, solid spire, near end of appendages; other tables small with reduced spire . . . . *H. princeps* Selenka
3. No gigantic tables with long, conical spire; tables relatively small; sometimes very reduced 4
4. Tables with robust spire ending in 4 blunt teeth; margin of disk with upwardly directed knobs . . . . *H. occidentalis* Ludwig
4. Tables with reduced spire; margin dentate . . . . *H. imperator* n. sp.

Key II

Skin not especially rigid, often soft; either burrowing or clinging to rocks (not an entirely natural group).

1. Elongated forms with small tentacles; no marked difference between dorsal and ventral sides 2
1. Stouter forms; large tentacles; dorsal and ventral sides different 4
2. Tables with few (8–12) spines on top of slender spire; disk reduced completely (except in very young specimens); also large flat rods with dentate margin or a series of holes; anterior end tapering; small yellow tentacles; appendages scattered, ventrally cylindrical, dorsally more papilliform without marked difference between the two sides . *H. surinamensis* Ludwig
2. Tables with numerous spines on top of spire; disk well developed with large central hole; oval buttons with 3 pairs of holes 3
3. Tables large with 8 marginal holes, almost as large as the central hole; disk large, squarish; spire with many spines on top; buttons with large holes; tentacles small; no difference between dorsal and ventral sides; appendages usually on warts; cylindrical on ventral side, more papilliform on dorsal; skin very rough to touch; color variable, mottled brown and gray. *H. impatiens* (Forskål)
3. Tables small with from 4 to a complete ring of small holes around the large central hole; delicate in structure; buttons with small to almost obliterated holes; normally 3 pairs; appendages cylindrical, scattered and not on distinct warts; very few seem to be developed as papillae; color grayish, generally more or less rust color, at least anteriorly, and either small stains of black irregularly spread or two rows of large dark patches along the dorsal side . . . . *H. arenicola* Semper
4. No tables (except possibly in very young specimens); deposits branched rods often with curved ends, few and scattered; dark brown with dendritic almost black tentacles; integument soft, smooth . . *H. glaberrima* Selenka

4. Numerous tables with a variable number of marginal holes; disk squarish; numerous teeth on top of spire; numerous elliptic buttons, often obviously curved; small yellowish brown form, contains a green pigment, which is extracted in alcohol; anal papillae often calcified. . . *H. parvula* (Selenka)

Key III

Distinct difference between dorsal and ventral side; large ventrally directed tentacles; a natural group which seems to prefer quiet, very shallow water; they seem never to bury themselves nor to cling to rocks. Deposits small rosettes or plates; tables with small disk and high spire with 12 spines on top.

1. Plates with 2–4 larger holes; a few terminal ones which are small; margin of plates with blunt teeth; collected in heaps, visible to unaided eye; tables with spinous margin of disk; tentacles 20–25; stone canal single; color dark grey with yellow pedicels . . . . *H. grisea* Selenka
1. Plates not with large holes and dentate margin; deposits mostly either rosettes or biscuit-shaped plates; tentacles 20; two tufts of stone canals. . . 2
2. Rosettes dominating in skin, distinctly in heaps; color variable, often with large dark spots, sand colored or dark reddish brown; maximum size about 25 cm., usually 15 cm.; skin not remarkably thick. . . *H. floridana* Pourtalès
2. Rosettes not present; numerous roundish, biscuit-shaped bodies with small holes in several rows; color, as a rule, dark brown above and pale yellowish to flesh-colored below; bases of ventral appendages dark bluish *H. mexicana* Ludwig

Holothuria cubana Ludwig

Plate **1**, figs. 1–8

Holothuria cubana Ludwig, 1875, p. 28, fig. 34.
Stichopus rigidus Selenka (partim), 1867, p. 317, pl. 18, fig. 30, 31.
Holothuria pleuripus (Haacke), Sluiter, 1910, p. 332.
Holothuria hypamma Clark (partim), 1921, p. 495.
Holothuria fossor Deichmann, 1926, p. 18, pl. 2, fig. 1, 1a-j.

The following is Ludwig's description translated.—"Twenty very small tentacles; the dirty white body of the single specimen is sausage-shaped; the entire surface is covered by appendages; anus is round; skin rough to touch on account of the numerous deposits; these are represented by a crowded layer of knobbed buttons which, as a rule, are perforated by 10 holes; beside these we find others which are irregular in their outline, smooth and perforated only by a few small holes, thus being transformed into plates. The tables are very clumsy; the spire is low and with many teeth; the disk is provided with knobbed thickenings as are the buttons. The shape of the calcareous ring is seen in

fig. 34c; Polian vesicle 1.5 cm. long; stone canal embedded in dorsal mesentery; the few times divided genital tubes, up to 6 cm. in length."

Maximum length of specimens examined about 15 cm. (from Bermuda), usually 6–8 cm., smallest specimen 3 cm.

A very characteristic form, flattened, with thin, rigid skin, except in very young specimens; mouth ventral with 20 very small tentacles; anus terminal. Appendages small, slightly tapering pedicels ventrally, rather scattered and, as a rule, completely retracted, visible only as small pits; dorsally they are small wart-like papillae, usually distinct along the sides and in scattered rows along the dorsal ambulacra. Color gray to whitish, dorsally often with 6 pairs of indistinct spots; ventral side lighter and often with a rusty stain at the bases of the appendages.

Internal anatomy.— A small, low and delicate, calcareous ring, with undulated posterior edge, of the same type as that of *H. pseudofossor;* tentacle ampullae small; Polian vesicle single; one small stone canal with small round head, placed to the right and partly attached to the mesentery. Course of intestine typical, that is, first loop is attached by mesentery along left side of right dorsal muscle band, second loop runs across left dorsal and ventral band and the midventral band, and the third loop runs along the right side of the midventral muscle band; rete mirabile is small; respiratory trees of almost equal size, running through the entire length of the body cavity. Longitudinal musculature thin. Genital organs as divided tubules, attached just behind the vascular ring; they are extremely long when ripe.

Selenka says that this species is provided with branched Cuvierian organs; a brown mass is present near the cloaca, but no distinct structure could be found in it.

Deposits.— An outer layer of densely placed large tables (diameter 0.05–0.08 mm.) resembling reticulated spheres, with a broad disk with large central hole and numerous smaller marginal ones; brim knobbed; spire low with numerous teeth on top, but these are often united with secondary outgrowths from the disk, in such a manner that the entire outer part of the table becomes covered by a reticulated meshwork. The tables are usually smaller and more simple ventrally, especially in the appendages, and here the different stages in the development may be observed. In very young specimens the skin is thin and we find here the primitive tables (fig. 5) as well as some typical, and these simple tables have a higher spire with a few, small spines on top, and the disk is almost smooth.

The inner layer of deposits is, in the adult, composed of a great number of regular knobbed buttons; dorsally they are, as a rule, provided

with 3 pairs of holes and are about 0.04 mm. long; ventrally they have 4–6 pairs of holes and are about twice as long; many are also less knobbed or even smooth.

In the pedicels a small but well-developed end plate and numerous plate-like rods, either developed as elongate smooth buttons (0.08–0.13 mm. long), or as more irregularly formed smooth plates with a few irregularly distributed holes and often a low longitudinal ridge; these latter are very typical for the full grown animal and have been figured by Ludwig, but one has to select a piece of skin which has one or more pedicels or else one will miss them. In the papillae apparently no end plate is present; there are curved rods alone, with broadened middle and some perforations. In the tentacles I have been unable to find any deposits.

In young specimens the inner layer of buttons is less developed; the buttons are furthermore smooth and of the large type, with 4–6 pairs of holes; the characteristic plates in the appendages are not present; we find only elongate rods with a few holes near their ends; probably the supporting plates arise from these rods. The tables are also generally of a simpler type, as mentioned above.

Remarks.— This species resembles in its outer form *H. pseudofossor*, which seems to have more cylindrical and larger pedicels on the ventral side, and besides the papillae a number of appendages developed as pedicels on the dorsal side; the appendages in *pseudofossor* are less apt to contract; because of some peculiarity of the skin we find that foreign particles also seem to cling better to the skin. The two forms are, however, so much alike that an examination of the spicules is necessary to make sure of the determination.

H. cubana differs distinctly from *H. pseudofossor* in the form of the spicules, as the figures clearly show; the latter species has more simple tables with few, regular holes in the margin of the disk and never the large supporting plates. *H. rigida* (Selenka) from the Society Islands, with which this species has been confused, has more simple tables and usually 5–8 pairs of holes in the knobbed buttons. *H. hypamma* Clark, also from the Pacific Ocean, differs by having more irregularly developed knobbed buttons and also just as in *rigida*, less complicated and smaller tables, and supporting rods of the common, slender type.

The reason why Ludwig's species, described in 1875, has escaped attention is simply because he described the smooth supporting plates from the feet, as buttons belonging to the body wall. Clark (1919) has pointed out that Selenka combined the description of two forms,

namely that of typical *H. rigida*, from the Society Islands, and that of the form from Florida, which Clark temporarily united with his *H. hypamma* from Mer, Torres Straits.

Sluiter says about his specimen of *H. pleuripus*, from Kingston: "corresponds exactly with the description which Théel gives of Haacke's specimen from Mauritius." Most likely Théel had *H. rigida* at hand; *pleuripus* and *rigida*, both Indo-Pacific forms, seem to be very closely related; our knowledge of all these forms with knobbed buttons and complicated tables is, however, still imperfect.

Type locality.— Off Cuba.

Type in Vienna Museum.

Also known from Florida (Selenka's type locality), Curaçao, Barbados and Bermuda. A burrowing form which hides itself in sand, under rock fragments.

Holothuria pseudofossor spc. nov.

Plate **1**, figs. 9–14

Examined 10 specimens

Largest typical specimen seen, about 10 cm. in length; outer shape much like that of *H. cubana;* skin stiff from numerous deposits, tentacles small, ventrally directed; anus terminal, appendages mostly well expanded, apparently larger and more cylindrical on the ventral side, smallest near the midline; dorsally they seem to be mostly papillae and some of those placed near the dorsal radii are slightly larger. Color whitish; larger dorsal appendages often with a narrow dark ring around their base. Most specimens are covered with sand which clings firmly to the integument, and this peculiarity together with the large and usually well-expanded feet will in most cases serve to separate this species from *H. cubana.*

Internal anatomy like that of *cubana:* a very low and delicate calcareous ring, short tentacle ampullae; vascular ring about 1 cm. behind the calcareous ring; one Polian vesicle and one short, coiled stone canal with rounded head, embedded in the dorsal mesentery. Intestine short, its course as usual; mesentery narrow, forming a complete membrane; respiratory trees slender, with small lateral branches; rete mirabile small; muscle bands thin, with broad free margin; genital organs very long and slender tubules divided near their base, attached just behind the vascular ring.

Deposits.— Tables and regular, knobbed or smooth buttons. Tables of divers sizes, averaging about 0.07 mm. in diameter; rim smooth or

knobbed; central holes large and usually 8 regular marginal holes; spire low, solid, ending in numerous teeth; the tables seem never to develop into such complicated forms as is the case in *H. cubana.*

Buttons varying in size from 0.02–0.1 mm., with smooth to undulated or knobbed surface and with strongly undulated margin, and frequently with the middle bar projecting beyond the end of button, often provided with a few knobs; smaller and larger buttons are found intermingled, with 3 to 7 pairs of holes respectively.

In the pedicels which are covered to their ends by deposits, a well-developed end plate is found, and numerous very large supporting rods, almost straight, with perforated ends and widened out and perforated near their middle; in the papillae the end plate is lacking or very reduced; the end plates are mostly curved. The appendages also contain numerous tables and buttons, as in the other species of this group. The tentacles contain some heavy curved rods with pointed ends, sometimes with a few small perforations, as well as numerous small curved rods, which are smooth or with a few small spines.

Seems to be very closely related to *H. cubana* and probably has a similar distribution and biology.

Type locality.— Montego Bay, Jamaica.

Type in Museum of Comparative Zoölogy, cat. no. 917.

At present known only from the type locality.

Holothuria princeps Selenka

Plate **2**, figs. 1–8

Holothuria princeps Selenka, 1867, p. 332, pl. 18, fig. 67–69.

Type and half a dozen other specimens examined

The largest well-expanded specimen measured about 20 cm. in length, but, as a rule, the specimens are contracted to short, firm barrels. An almost cylindrical form with very little difference between ventral and dorsal side, excepting that the midventral appendages are slightly smaller. Mouth subterminal with very small tentacles, 20 in number; anus terminal. The body is covered with conical appendages, which in some cases end in a distinctly cylindrical pedicel with a large end plate; in others they are distinctly conical to their end with only a small vestige of an end plate; these two forms seem to be mixed irregularly with each other, and in many cases it is impossible to determine the kind. The integument is thin, flexible in spite of the numerous deposits, except when contracted. Color yellow with darker patches dorsally;

often the pigment is rubbed off. The appendages are usually somewhat paler in color; their bases are, however, often provided with a darker ring.

Internal anatomy not peculiar, except that the calcareous ring is very high and stout; each radial piece sends a short prolongation backwards, which often has a low notch, like the "tail" of the ring in a Cucumaria, as Selenka describes it; this notch may be filled out by a calcareous mass. One Polian vesicle; one stone canal unattached and with an oblong soft head.

Course of intestine as usual. Respiratory trees very strongly developed with wide stems and numerous short tufts; no Cuvierian organs have been observed; cloaca large; genital organs long divided tubules, fastened several cm. behind the vascular ring, in the examined large specimens.

Deposits.— Tables and buttons. Tables of two types: in the body wall small ones with irregular disk, large central hole and variable number of marginal holes which may be entirely wanting, and dentate to undulated margin (diameter about 0.04–0.06 mm.); spire low and on its way to becoming reduced; often one of the four rods is lacking; the top ends in few blunt teeth or none. In the terminal part of the appendages very large tables are present; they may be observed even with the unaided eye and the spire is simply gigantic, solid and ends in a smooth cone (height 0.3 mm.).

The buttons are irregular, as a rule incomplete, of the six-holed type, variable in size and with low knobs on the middle bar and sometimes also on the margin; their size varies from 0.04–0.05 mm.

In the appendages numerous supporting rods; relatively short (0.2 mm. long), with large holes near the expanded middle and at the ends, sometimes curved. In the pedicels a large end plate, in the papillae a mere vestige.

Remarks.— This species cannot at present be confused with any other form from the West Indies; no other species is known which has such large tack-like tables. A few closely related forms, belonging to the same group, are known from the Indo-Pacific Ocean. One is known from Taboga, Panama, but the spicules of these forms have not as yet been compared and measured. It seems as if the species with this kind of deposits form a special group within the genus Holothuria, and apparently quite distinct from the group in which, for example, *H. cubana* is placed, which also is a form with numerous deposits. The similarities are most probably due to a similar mode of life.

Type locality.— Florida.

Type in Museum of Comparative Zoölogy, cat. no. 685.

This species is represented by several specimens from Florida and a single one from San Domingo, in United States National Museum.

Holothuria occidentalis Ludwig

Plate **2**, figs. 9–17

Holothuria occidentalis Ludwig, 1875, p. 28, fig. 35.
?Holothuria sulcata Ludwig, 1875, p. 25.

Ludwig's description.— Twenty tentacles. The present specimen is 13 cm. in length and covered with appendages all over the body; the ventral side is rather smooth, whereas the dorsal side makes a more warty impression. The color of the animal is brown on the back and much paler on the ventral side. A slight longitudinal furrow is present in the midline of the trivium. The skin is about 4 mm. in thickness. The following deposits are present: (1) buttons; these are perforated by 4–10 holes and provided with rounded knobs; (2) tables; these are rather small and clumsy; the crown is provided with 4 times 3 teeth; the basis also carries blunt teeth; (3) long, knobbed supporting rods and rather symmetrically developed supporting plates in the wall of the feet.

The calcareous ring has the form which is indicated by fig. 35e. The stone canals are present in two tufts, one on each side of the dorsal mesentery; the left tuft consists of 9, the right of 12 stone canals with the ends (heads) laterally compressed. The brownish colored Polian vesicles are 1–1.5 cm. in length and 3 in number. A bundle of genital organs is found on left side of the dorsal mesentery; average length of the tubules is $1\frac{1}{2}$–2 cm., divided near their ends."

With some doubt I have identified a Holothurian as *H. occidentalis* Ludwig, which was collected by Dr. Th. Mortensen, off Fredriksted, St. Thomas, Virgin Islands, 200 fathoms depth.

The specimen examined is about 15 cm. in length, with ventrally placed mouth, surrounded by very small tentacles and with terminal anus. The body is slightly tapering and somewhat flattened with relatively few, conical appendages which are smallest dorsally and ventrally, and largest laterally; in its outer shape it reminds one somewhat of *H. martensii* Semper but, as a whole, it is more robust. The ends of the appendages are in most cases contracted, and they seem to lack end plates; most likely the majority will prove to be papillae and the others cylindrical pedicels as in *H. princeps*. Color dorsally brown-

ish, paler ventrally, and the appendages still paler. Skin rigid, thin, filled with deposits.

Calcareous ring relatively strong, stout; each radial with a short posterior prolongation, with deeply concave margin, same type but less pronounced as in *H. princeps;* tentacle ampullae very small; 4 large Polian vesicles and, between these, tufts of much smaller ones (which probably have been regarded as accessory stone canals by Ludwig). One large stone canal fastened to the dorsal mesentery, with large irregular head, free to the right. Intestine long, mud filled; course as usual; cloaca large; right respiratory tree as usual attached in right lateral interradius; left entangled in the very poorly developed rete mirabile; its basal part is completely hidden in the large, unbranched, yellowish white Cuvierian organs. Genital organs long and slender, few times branched, attached about 1 cm. behind the vascular ring.

Deposits.— Tables and buttons. Tables robust with large central hole and 8–12 small marginal holes, margin of disk undulated, often with blunt spines on the outer side (the side of the spire); diameter of disk about 0.06–0.08 mm.; the spire is low, with 1 or 2 cross beams, and ends in 4 blunt teeth; the tables are of very uniform size; they seem to increase slightly in size toward the end of the papillae. Buttons irregular, often incomplete and with few knobs; in many cases the holes are almost obliterated; when complete they have, as a rule, 6 holes; their length varies from 0.05–0.08 mm. In appendages numerous rods with laterally placed holes near the middle or for their entire length, thus resembling very large buttons; they seem to be most numerous in the dorsal appendages where they often are somewhat curved; no end plate has been found.

Remarks.— The only differences between the description given here and that of Ludwig is that the spire of the tables in his description is provided with 12 teeth whereas I have found only 4, but the tables in the group to which *H. occidentalis* belongs seem to change much, and the spire is often reduced, as for example in *H. princeps.* Neither has it been proved that his bundles of stone canals are identical with the small accessory Polian vesicles of the present species.

Nothing is known about the habits of this species; it is apparently a form which lives at greater depth than most of the members of the genus Holothuria and that accounts for the few specimens which have been collected.

Type locality.— West Indies.

Type in Hamburg Museum.

Holothuria imperator sp. nov.

Plate 3, figs. 1–11

Of this species 6 large specimens are at hand, about 25–30 cm. in length. A stout, cylindrical form with blunt ends; mouth ventrally directed, anus terminal. Twenty tentacles of medium size. Body almost uniformly covered by small, not too crowded papillae, not on distinct warts; a wart-like appearance is, however, artificially produced when the skin is strongly contracted; anus surrounded by five clusters of papillae. Skin thick, with numerous deposits, but in spite of this fact it is not rough to the touch as in *H. princeps*. Color of integument yellow, darker dorsally; each papilla being surrounded by a dark spot; these spots are largest dorsally.

Internally we find a high, well-developed calcareous ring; the radials provided with short posterior prolongations; the space between the prolongations seems to be filled out by a calcareous mass of a slightly different color. The tentacle ampullae are short, 1.5 cm. long in the largest specimens. The vascular ring is placed about 1 cm. behind the calcareous ring; Polian vesicle, ventrally placed, single; stone canal dorsal, free with a soft elongate head resembling a sack. The long sand-filled intestine has the normal course; the third loop is attached closely along the right side of the broad midventral muscle band. Respiratory trees large, provided with wide stems and extremely fine lateral tufts of branches; the right branch is attached in the right lateral interambulacrum; the left is as usual entangled in the rete mirabile. The muscle bands are broad. The genital organs are unripe in the specimens examined, but are present as a bundle of thin, thread-like tubules on left side of mesentery, only 1–2 cm. long, attached a few cm. behind the vascular ring.

Deposits.— The deposits are chiefly buttons (0.04–0.05 mm. long), of the six-holed type in most cases with very small holes; near the appendages we often find much larger buttons (0.08–0.09 mm. long), with several holes, irregular and often with secondary network.

Tables are present, but in the large specimens examined they are found only in the appendages and near these; they consist of a four-holed disk (diameter 0.05–0.08 mm.), with usually a circle of marginal holes and a dentate margin; spire much reduced. In younger specimens one would probably find more complete tables.

In the appendages no end plate seems to be present; a number of supporting rods are present of the normal type (0.2 mm. long), straight,

with a few perforations near the ends and one or two along the middle. In the tentacles, we find small simple rods.

Remarks.— I have been unable to identify this species with any other previously described. Although easily distinguished, it is undoubtedly related to *H. princeps*, the shape of the calcareous ring being almost identical. Most likely the two species have similar habits.

Type locality.— Yucatan.

Type in United States National Museum.

Holothuria surinamensis Ludwig

Plate 3, figs. 12–15, 19

Holothuria surinamensis Ludwig, 1875, p. 35, fig. 27; Deichmann, 1926, p. 12, pl. 1, figs. 1, 1a-g, 2a-b (list of references).

Holothuria languens Semper (partim), 1868, p. 87, 248.

Holothuria subditiva Selenka, 1867, p. 338, pl. 19, fig. 87 (partim).

About 100 specimens examined

Specimens from 3–20 cm. length have been examined. Body cylindrical, with terminal mouth and anus; tentacles 20, medium sized; no pronounced difference between dorsal and ventral sides; appendages scattered, rather uniformly distributed, present as cylindrical pedicels on ventral side, and as smaller, more conical appendages which form transitional stages to papillae; the specimens show some differences with regard to the development of pedicels or papillae; the dorsal appendages are often on low warts. Color, all shades from faded brown to dark purplish, with darker patches on the dorsal side and with tip of appendages paler; the ventral side is often paler. Skin thin, flexible, often rough to touch.

As the species multiplies by fission, complete animals are often difficult to get; the anatomy of quite intact, non-regenerating specimens, collected in Jamaica by Dr. H. L. Clark, has been studied here.

Calcareous ring low with broad radials and small interradials; posterior edge of ring somewhat undulated. Tentacle ampullae long: 1 or 2 slender Polian vesicles; one free stone canal with oblong head on left side of mesentery.

Intestine short; first loop running from left dorsal muscle band to right muscle band, second loop along lower side of left dorsal band, bending backwards a little anterior to the middle of the body cavity; the third loop running along right side of midventral muscle band. Respiratory trees long and slender. In none of the perfectly intact

specimens was any trace of Cuvierian organs observed, but the well-developed rete mirabile may perhaps in some cases look as if it were a bundle of Cuvierian organs (Ludwig mentions that they are present). Muscle bands broad, thin, without free margin. Genital organs attached a little anterior to the middle of the body cavity.

Deposits.— Tables and large flat rods with dentate edge. Except in very young specimens, where the disk is large and the spire high with several cross beams, the typical form of the tables (height 0.05 mm.) is absolutely devoid of disk; the inner end of the table is almost conical; the outer end provided with 4 vertical teeth and 8 horizontal double teeth (one has to use a large magnification to be sure of the fact that the teeth are double; in the feet the teeth are mostly simple; Ludwig has, however, noted this character in fig. 27). The outer end of the table is larger than the inner, and sometimes the top has been mistaken for the disk, as Théel has pointed out in his "Blake" report.

Long flattened rods (about 0.5 mm. long), with dentate margin are found in variable number; they are most numerous in the appendages where they are more or less curved and obviously function as supporting rods. End plate developed in accordance with the form of the appendage; in tentacles larger and smaller curved rods, usually with some spines.

Seems to be closely related to *H. languens* from Panama, which has hitherto been collected only in small numbers, not well suited for comparison; the tables are, as a rule, smaller in *languens*, more slender, provided with simple teeth on top of spire; inner end of spire not conical, but flattened (plate **3**, fig. 16).

Type locality.— Surinam.

Type in Würtzburg Museum.

A very common form usually occurring in great numbers. Known from Surinam, Barbados and probably also Florida. Selenka's *H. subdivita* from that locality is partly *H. surinamensis*, but I know of no other records from that well-explored locality, and I doubt the correctness of this very much. Common in Bermuda and Jamaica.

Holothuria impatiens (Forskål)

Plate **3**, figs. 17–18

Fistularia impatiens Forskål, 1775, pl. 39, fig. B.

Holothuria botellus Selenka, 1867, p. 335.

Holothuria impatiens Lampert, 1885, p. 65 (list of references). Theél, 1886, p. 233. Fisher, 1907, p. 666, pl. 69, fig. 4a. Clark, 1901b, p. 259; 1901c, p. 494; 1919, p. 63. Sluiter, 1910, p. 333. Deichmann, 1926, p. 11.

Maximum length about 15–20 cm. Form cylindrical with the anterior end sometimes extended as a long slender "neck"; mouth almost terminal with 20 medium-sized tentacles; anus terminal. Appendages few, uniformly scattered and, as a rule, placed on distinct warts, except in abnormally expanded specimens; ventrally they are developed as cylindrical pedicels; dorsally we find all stages between true pedicels and papillae. Skin thin, flexible, very rough to the touch. Color variable, different shades of grey mottled with larger and smaller patches of brown; sometimes small white spots are visible due to the deposits which may be collected in heaps.

Internal anatomy.— A low calcareous ring with broad square radials and small interradials; posterior edge undulated. Medium-sized tentacle ampullae; 1 or 2 Polian vesicles; normally one free stone canal, but in very large specimens I have observed 2 accessory canals. Intestine short, the course as in *H. surinamensis.* Muscle bands broad, well divided without any free margin. Cuvierian organs very large, white and transversely furrowed. Respiratory trees long and slender. Genital organs as long, thread-like tubules which originate far back near the middle of the body cavity, somewhat posterior to the bending between the second and third loop.

Deposits.— Tables and smooth, regular, six-holed buttons. Tables with large squarish disk (diameter 0.08–0.1 mm.), with 8 marginal holes and one central hole, about equal in size; accessory small outer holes may be found. Strong, robust spire ending in numerous small teeth, usually two cross beams, excepting in very young specimens, where the spire is higher and more tapering, and in the appendages, where the tables may show some irregularity. An inner layer of numerous, large (0.08 mm. long), regular, very smooth buttons, often collected in heaps. They are provided with 6 large holes and seem not to change during age.

Well-developed end plate in the pedicels, small in the papilliform appendages. Supporting rods, straight in the former and curved in the latter, with few holes in the ends, and strongly widened at the middle with some large perforations.

In tentacles, large and small curved rods with pointed ends and smooth surfaces.

Type locality.— Suez.

Type not preserved. In spite of all efforts it has been impossible to find any difference between the Indo-Pacific form and the West Indian; this fact has already been pointed out by Selenka. *H. impatiens* occurs also in the Mediterranean Sea, but seems not to be recorded from the West African islands.

Most likely this species occurs all over the West Indies; it is not yet recorded from Bermuda. Most collections contain but few specimens. A great number of specimens have been collected by H. L. Clark in Jamaica and Tobago (Museum of Comparative Zoölogy); a single specimen, brought home by the Antigua-Barbados expedition and 3 specimens from Porto Rico are all that are to be found in the United States National Museum, Washington.

Holothuria arenicola Semper

Plate **4**, figs. 1–9

Holothuria maculata Brandt, 1835, p. 46, 47 (Sporadipus, subgenus Acolpos). Ludwig, 1881, p. 595; 1883, p. 156, 157, 167, 168. Lampert, 1885, p. 73. Sluiter, 1910, p. 332. Not *Holothuria maculata* Chamisso and Eysenhardt, 1821.

Holothuria arenicola Semper, 1868, p. 61, pls. 20, 30, fig. 13; pl. 13, fig. 4. Théel, 1886, p. 222.

Holothuria subditiva Selenka, 1867, p. 338, pl. 19, fig. 87 (partim).

Holothuria rathbuni Lampert, 1885, p. 73. Theél, 1886, p. 268. Clark, 1901a, p. 343; 1901b, p. 259, pl. 37, figs. 7–10; 1919, p. 63. Verrill, 1901, p. 37, figs. 6a, b; 1907, p. 145, fig. 37. Sluiter, 1910, p. 332. Deichmann, 1926, p. 13.

Holothuria sp. Rathbun, 1878–82, p. 141.

About 50 specimens examined

Largest specimens measured about 15 cm. long; young specimens few cm. long are however recognizable. Cylindrical, slender form, tapering, with almost terminal mouth and 20 very small tentacles; anus terminal. Appendages, exclusively pedicels, cylindrical and of almost the same size both dorsally and ventrally; arranged in five broad bands, with narrow naked stripes between, corresponding to the radii; they are not crowded and often strongly contracted; in some cases they may appear to be placed on low warts, but these are never so large and are always much more numerous than in the two other cylindrical forms, *H. impatiens* and *H. surinamensis*, and the skin is also much less rough to the touch than in those species. Color very variable, to some extent the coloration seems to depend on the locality in which the animal lives; it varies from gray, sand colored, with large dark patches in two series along the dorsal side, to gray with numerous small stains irregularly scattered over the entire surface; in some cases the specimens are almost rust color, as if they had been in contact with iron, and in others they are almost black; the two latter kinds of coloration

may be due to external conditions, but the small spotted and large spotted forms seem to be distinct varieties and I have never noticed that they both occur in the same locality. We are at present unable to distinguish between the forms which are found in the Pacific and Atlantic Oceans; if they, in spite of all, should prove to be different the name *rathbuni* must be applied to the Atlantic form.

Internal anatomy.— A low calcareous ring, the radial pieces often projecting a little beyond the posterior edge and slightly incised; tentacle ampullae small; vascular ring a remarkably long distance (1 to 2 cm. in large specimens) from the calcareous ring. As a rule, only one stone canal with small round head is found hanging free near the dorsal mesentery, but in a very large specimen I have found two at this place; 1 to 2 Polian vesicles. Course of intestine not remarkable; dorsally it changes from the left to the right dorsal muscle band, then it runs along the lower side of the left dorsal muscle band, proceeds forward for a longer distance than in *H. impatiens* and *H. surinamensis*, and in the third loop it runs near the midventral muscle band without touching it. Respiratory trees as usual; rete mirabile small; Cuvierian organs have been observed in all well preserved, intact animals, but always as very small tubes in an easily overlooked tuft; probably they are on the way to becoming atrophied. Genital organs as divided thread-like tubules; they originate about 1 cm. behind the vascular ring level with the anterior turn of the third intestinal loop.

Deposits.— Tables and buttons. Tables with relatively small delicate disk (diameter 0.05–0.06 mm.), with large central holes and, generally, 4 marginal holes, or a complete series of about 8. Spire low, tapering, with one or two cross beams, and ending in a variable number (usually 8–12) small teeth. In young specimens the disk is, as a rule, complete and the spire is higher with more cross beams; in old specimens some of these tables are retained in the terminal portion of the oral and anal appendages, but the holes in the disk are reduced and the spire is shorter. The buttons (length 0.04–0.06), which are missing in the smallest specimens, are regular, smooth, with 6 holes of variable size; the holes are apparently reduced with advancing age, but small holed buttons may be present even in relatively small specimens, 4–5 cm. long. In the pedicels a large end plate, composed of several small pieces, and also numerous straight supporting rods (0.15–0.17 mm. long), with a few holes near the ends and along the middle; some of them developed as buttons with a regular row of holes on each side.

The deposits show some range of variation in a single specimen, but, on the whole, they are very constant in the species, and a series of prepa-

rations, taken from specimens from all over the world, has failed to show any difference in size or form.

The type locality was Bonin Island, where Brandt found the small spotted form, which also occurs in Panama and at several places in the West Indies, as does the large spotted form which Semper described from Bohol; he also reports the large spotted form from Surinam.

Remarks.— Synonymous with this species are *H. humilis* Selenka from Hawaii and *H. subditiva* Selenka from Panama and Florida.

Brandt's species has latterly been listed as a synonym of Semper's *H. arenicola*, as the name *maculata* has to be used for a species of *Synapta*, but both Brandt's and Semper's names have been used indiscriminately.

The name *H. rathbuni* was introduced by Lampert, 1885, who thus named a species from Bahia, secured by Rathbun. From the description given by Rathbun it is quite evident that it is *H. arenicola* which is known from this locality; the only difference being that Rathbun describes a knobbed calcareous deposit, which probably came from one of the species of *Thyone* examined from the same locality.

The name *rathbuni* has been applied to the small spotted form as well as to the large spotted form. Sluiter seems to have used the name *rathbuni* only for the small spotted form; regarding the large spotted form, which he calls *maculata*, he says that he is unable to separate the West Indian form from the one which occurs in the Pacific Ocean.

Seems to be common all over the West Indies from Bahia to Bermuda; under rocks, uncovered by low tide; sluggish, and usually buried more or less deeply in the sand.

Holothuria densipedes Clark

Holothuria densipedes Clark, 1901, p. 257, p. 17, fig. 1.

Only one very small specimen, about 8.5 cm. in length, has ever been found of this peculiar form, which probably is an abnormal *H. arenicola* Semper. It suggests that species strongly, except for the feet which are more conical, soft, as if they were swollen and apparently more numerous, but to estimate about the number of appendages in a very contracted Holothurian is a difficult thing.

In the internal organization we find that the vascular ring is placed about one cm. behind the calcareous ring, where the well-developed genital organs also take their origin; this character we find also in *H. arenicola*. The Cuvierian organs are long and fine; in all the specimens of *H. arenicola* which I have seen they are fine but short. This is the

only difference which I have been able to detect, and it is not a very important character. The spicules cannot be separated from those found in *H. arenicola*.

Type locality.— Lighthouse Reef, Porto Rico (H. L. Clark).

Type in United States National Museum.

Holothuria glaberrima Selenka

Plate 4, figs. 10–13

Holothuria glaberrima Selenka, 1867, p. 328, p. 18, figs. 57, 58. Semper, 1868, p. 92. Lampert, 1885, p. 65; 1896, p. 58, 59. Clark, 1901b, p. 259; 1919, p. 63. Sluiter, 1910, p. 333. Deichmann, 1926, p. 17.

Holothuria lubrica var. *glaberrima* Mitsukuri, 1912, p. 96.

About 50 specimens examined.

Maximum length seems to be about 10 cm. A very characteristic form, soft-skinned, with a crown of large dendritic, black tentacles, which usually are ventrally directed in preserved specimens. Body relatively short, cylindrical; ventral side forming a distinct sole with numerous cylindrical feet; dorsally only small conical papillae or papilliform pedicels, not so numerous as the ventral appendages. Color varying from almost black to faded brown; a single almost white specimen has been found among several typical ones; never any patches or patterns on the dorsal side.

Internal anatomy.— A well-developed calcareous ring with high, squarish radials and much lower interradials. Long tentacle ampullae; Polian vesicle single, long and slender; stone canal free with elongate head on the right side of mesentery. Intestine runs parallel with the right side of right dorsal muscle band, closely along the lower side of the left dorsal muscle band and then parallel with the right side of the midventral muscle band. No Cuvierian organs; the type specimen has been examined, and what was supposed by Selenka to be Cuvierian organs are only some of the genital tubules which have become pressed through a rupture in the place where the Cuvierian organs normally occur. Genital organs originate behind the vascular ring and are several times divided, long tubules. Fleshy, distinctly divided muscle bands.

Deposits.— Rods alone have been found, even in the smallest (4–5 cm.) specimens, but it is likely that still smaller specimens will have tables also, as Mitsukuri has found in the case of *H. möbii* Semper. The deposits are straight or curved rods with branched ends; the

branches unite often and thus form series of holes along the edge (length 0.06–0.07 mm.); a few very small knobs may be found on the surface of the spicules near the end, but they are visible only with very high magnification. The spicules are never spinous as is the case with the spicules in *H. lubrica* Selenka, from the Pacific Ocean.

In pedicels a well-developed end plate, large in the ventral and small in the dorsal appendages. No supporting rods except the rods of the body wall which are found also in the tentacles.

Type locality.— Bahamas.

Type in Museum of Comparative Zoölogy.

Common in most parts of the West Indies. According to Selenka, it occurs also in Panama; these specimens are said to be in Göttingen, but I doubt the correctness of the determination; at least Dr. Mortensen and I have both failed to find the species there.

The habits of this species have been studied by Dr. W. K. Fisher, 1926, p. 17: "It clings to the outer side of the surf-washed rocks, usually where a tough kelp is growing."

Holothuria parvula (Selenka)

Plate **4**, figs. 14–22

Mulleria parvula Selenka, 1867, p. 314, pl. 38, fig. 17, 18. Semper, 1868, p. 77. Lampert, 1885, p. 76. Theél, 1886, p. 199. Sluiter, 1910, p. 333.

Holothuria captiva Ludwig, 1874, p. 32. Lampert, 1885, p. 68. Théel, 1886, p. 220. Verrill, 1907, p. 321. Crozier, 1917, p. 560. Clark, 1919, p. 63, 64.

Actinopyga parvula Clark, 1919, p. 63. Deichmann, 1921, p. 199–215, text-figs. 1–3, 5–7; 1926, p. 20.

About 100 specimens examined

A small form not known to exceed a length of about 6–7 cm., flattened, with cylindrical pedicels on the ventral side, forming a kind of sole; dorsally papillae or papilliform pedicels, situated on low warts. Mouth ventrally directed with 20 large yellow tentacles and a broad collar of papillae. Integument is thick, gelatinous in young specimens, of medium thickness and more tough in older. Color yellowish brown, paler below, without any pattern; the integument in all observed cases contains a very characteristic green pigment, which is known also in *H. surinamensis* and *Actinopyga agassizi* (see Crozier, 1917).

The species is able to multiply by means of fission, and incomplete specimens may be found, lacking either oral or anal end; this holds even of some of the type specimens, which are in the possession of the Museum of Göttingen.

Internal anatomy.— A low calcareous ring of the usual type; tentacle ampullae well developed; one or two Polian vesicles and a small stone canal, the latter embedded in the dorsal mesentery. Intestine relatively short, even in intact normal specimens, a feature which speaks in favor of transferring the species to the genus *Holothuria*, inasmuch as all true species of *Actinopyga* have a very complicated course for their enormously long intestine.

The intestine runs, in the dorsal interambulacrum, almost in the middle, then forward, along the lower side of left dorsal muscle band, and finally in right ventral interambulacrum at some distance from the midventral muscle band, except near the cloaca. Respiratory trees, as usual in the genus, slender, with short branches projecting in all directions; the right attached with very few strings to body wall; the left entangled in the relatively small rete mirabile. Large bundle of Cuvierian organs which are very effective when the animal is captured. Genital organs as dichotomously divided, long tubules, originating close behind the vascular ring.

Deposits.— Tables and smooth buttons. Tables resembling those of *H. impatiens*, but usually somewhat smaller (diameter 0.06–0.07) with 8 marginal, often many accessory holes, and a well-developed spire with 2 cross beams and numerous small teeth crowded on the top. In the pedicels the spire may be somewhat higher and more tapering. Buttons elliptical, smooth (length 0.09–0.11 mm.), often distinctly curved and with 6 or more holes, of variable size and never placed exactly in pairs but always alternating.

In pedicels a large end plate and numerous bilateral perforated plates in company with very large buttons, with the number of holes greater than 6. In papillae, slightly curved rods with perforated ends and middle; in tentacles strongly arched rods with pointed or branched ends and spines on the outer side of the curvature.

Remarks.— The presence of small calcified anal teeth in some specimens has caused the present species to be referred sometimes to *Actinopyga*, but it seems best to place it in *Holothuria* because of its anatomical structure and spicules. It is very closely related to *H. difficilis* Semper, from the Indo-Pacific, and Selenka identified specimens of *H. difficilis* as *H. parvula*. The differences are very slight. *H. difficilis* is apparently constantly twice as large as the West Indian form when full grown, and much more brown, with brown tentacles instead of yellow; the green pigment seems to be lacking too. The spicules are very similar; it seems as if the tables are generally larger than is the case with those

of *H. parvula*, but the deposits show some range of variation. It seems better to keep the two forms separate for the present.

Type locality.— Off Florida.

Type in Museum of Comparative Zoölogy.

Distribution.— Common over most of the West Indian region and also known from Bermuda. Occurs usually in some numbers. It prefers the underside of stones and rocks and is known only from very shallow water.

HOLOTHURIA FLORIDANA Pourtalès

Plate 5, figs. 5–9

Holothuria floridana Pourtalès, 1851, p. 8. Selenka, 1867, p. 324, pl. 18, figs. 47–49 (partim). Edwards, 1905, p. 383 (partim); 1908, p. 254–301, pl. 1–5 (partim). Clark, 1919, p. 63 (partim).

Holothuria nitida, silamensis, heilprini Ives, 1890, p. 319, 320, 322, pl. 8, 1–15.

About 100 specimens examined

Maximum length of specimens examined, about 15 cm. A relatively slender form, reminding one somewhat of *H. grisea,* especially when young. Mouth slightly ventrally bent; anus terminal. Ventral side with numerous cylindrical pedicels which are rarely retracted; somewhat more numerous than dorsal appendages; in very young specimens they may be arranged in series; dorsally papillae on low conical warts arranged without any definite order, and, besides, cylindrical feet, somewhat smaller than ventral; the warts only conspicuous in young specimens.

Tentacles 20, yellowish, not particular large. Skin of medium thickness, except in some young and contracted specimens, where it is thick and more gelatinous. Color very variable, from almost white, with darker tips of pedicels, to very dark brown; specimens from certain localities very irregularly spotted. It is a characteristic feature that the deposits of the inner layer of integument are arranged in heaps around the bases of the appendages and these heaps are visible to the unaided eye.

Internal anatomy.— Calcareous ring thin with undulated posterior edge; vascular ring placed about 1 cm. from the calcareous ring in a specimen 10 cm. long; number of Polian vesicles variable, 1 to 3; stone canals placed in tufts on each side of dorsal mesentery and increasing in number with advancing age. Course of intestine, first loop from about middle of body cavity along right dorsal muscle band; second loop closely along lower side of left dorsal muscle band; third loop which

is much coiled, runs along right side of midventral muscle band; cloaca large; no Cuvierian organs; muscle bands thin, with free margins; respiratory trees as usual in the genus; right one long and slender, attached in right lateral interambulacrum; left one short and bushy, entangled in rete mirabile. Genital organs well developed in most larger specimens, consisting of a tuft of long slender tubules, divided once or twice near base and originating a few cm. behind vascular ring.

Deposits.— An outer layer of tables, somewhat variable in height and form of spire (0.05–0.06 mm. in height), which may be composed of either almost parallel or converging pillars; disk always small, with large central hole and 4 small holes in margin; very rarely holes are incomplete; spire ends in 12 long teeth, 4 of which are vertical and 8 horizontal.

Inner layer of deposits small rosettes (0.02–0.03 mm. in diameter), arranged in heaps; a few developed as perforated buttons, or as plates with larger holes, but never biscuit-formed with minute holes; rosettes are retained as such during the animal's entire life. Pedicels contain a well-developed end plate and a few slender supporting rods with branched ends; in papillae a small vestige of an end plate may be present and numerous supporting rods; in tentacles no deposits seem to be present.

Type locality.— Florida Reef.

Type probably never preserved.

Ranges from Florida, where it is extremely common, to the north coast of Cuba, Swan Island and as far south as to Colon, Panama, but it has apparently never been taken in the waters of the Lesser Antilles or South America.

A shallow water form which always seems to be collected at low water mark, often in great numbers.

Remarks.— The species was established in 1851 by Pourtalès; later Selenka in 1867 united it with a form known from the tropical Pacific. Semper in 1868 regarded the Pacific form as typical *H. atra* Jaeger, including *H. floridana*, and he regarded Selenka's *atra* as a variety of Jaeger's species, namely *H. atra* var. *amboinensis*.

Typical *atra* from the Pacific Ocean, or what nowadays is regarded as *atra*, differs from *H. floridana* in the constantly darker color, the more smooth and slippery skin, which contains fewer deposits, and in that the arrangement of rosettes in heaps is not visible to the unaided eye. The rosettes (Plate 5, figs. 10–14) are more simple; the tables are slightly higher than they are in *H. floridana*, facts which Fisher pointed out in 1907.

Edwards (1908) united *H. floridana* with *H. mexicana*, but the two species are entirely different. *H. floridana* has thinner skin, more variable coloration and quite different spicules, which are rosette-shaped even in the oldest specimens and distinctly collected in heaps; furthermore, it has a very different geographical and bathymetrical range from that of *H. mexicana*.

It is evident from the figures and descriptions given by Selenka, that he also united *floridana* with specimens of *mexicana*, 38 cm. long.

Holothuria mexicana Ludwig

Plate 5, figs. 15–20

Holothuria mexicana Ludwig, 1875, p. 25. Théel, 1886, p. 215. Clark, 1901b, p. 258; 1919, p. 63. Sluiter, 1910, p. 333. Deichmann, 1926, p. 16.

Holothuria africana Théel, 1886, p. 174, pl. 8, fig. 7.

Holothuria floridana Edwards (partim), 1905, p. 383; 1908, p. 236–301. Clark, 1910, p. 63.

About 50 specimens examined

Largest specimen about 50 cm. in length; specimens 15–30 cm. long are usually captured, smaller ones being rare.

A subcylindrical form with blunt ends; mouth ventrally directed, anus terminal; skin very thick and smooth; ventrally numerous, soft, cylindrical feet, often completely retracted and hidden in the thick integument. Dorsally, smaller and more scattered cylindrical feet and a few papillae, which in preserved specimens seem to be placed on warts, except when very young. Tentacles 20, broad, peltate, not increasing much in size during growth, so that they appear to be relatively small in large specimens. The typical coloration of preserved specimens is very dark, almost black on dorsal side and a dirty yellowish on ventral side and flanks; the ventral feet are often bluish or brownish, as is the area around their bases; now and then a spotted form is found, usually with the ventral side provided with large dark patches, whereas the dorsal side is pale.

The outer appearance of the adult is entirely different from that of *H. floridana*, which is more warty, more slender and has conspicuous small spots, due to the arrangement of deposits around the base of the appendages. The few young specimens of *H. mexicana* examined are sand-colored, with small dark spots on dorsal side, and with distinct warts, but the skin is more tough and no accumulation of spicules in heaps is visible.

Internal anatomy.— Very much like that of *H. floridana*. The cal-

careous ring is, even in young specimens, thicker and more clumsy, without any distinct posterior notch in the radials; tentacle ampullae remarkably small in large specimens; a variable number of Polian vesicles, usually 2 or 3, and a very great number of small stone canals hanging in a tuft on each side of dorsal mesentery, increasing in number with advancing age. The course of intestine is exactly as it is in *floridana;* cloaca very large; muscle bands broad but not especially strong, with broad, free margin. Genital organs several times divided tubules, originating in the first third of body cavity.

Deposits.— An outer layer of scattered tables with small disk, with 4 small marginal holes, rarely 8; spire strong with 4 vertical and 8 horizontal spines; these tables cannot be distinguished from those found in *H. floridana.*

An inner layer of innumerable small buttons or plates of two kinds: a small elongate four-holed button with 2 lateral and 2 smaller terminal holes (sometimes a few accessory outer holes may be present) and also biscuit-shaped plates, slightly larger (0.04 mm. in diameter), with very small holes arranged in several rows; this latter kind of deposit is derived from the simple four-holed deposits; the holes during growth becoming divided into smaller holes by outgrowth from the margin, and the holes are then reduced in size by being filled in with calcareous matter. All intermediate stages are present; the biscuit-shaped deposits are very numerous, even in specimens only 5–6 cm. long.

In the pedicels we find a well-developed end plate and practically no supporting rods; in the dorsal papillae a mere vestige of an end plate and some curved supporting rods with bifurcate ends; in tentacles a few curved stout rods with perforated ends and a few spines along the sides.

Type locality.— Gulf of Mexico, probably near Cuba, as the species seems to range from northwest of Cuba to Porto Rico, Jamaica, Lesser Antilles and down to Curaçao, but does not enter the western region of the Caribbean Sea.

Type in Museum of Hamburg (a small, immature specimen).

This form has been taken with the dredge in 3–10 fathoms depth; it is probably never exposed during low tide, as is the case with *H. floridana.* From Marianos Beach, near Havana, I have a single large specimen from a 3-foot depth, and Dr. W. K. Fisher notes that the species is quite common in eel grass at low water in Barbados. It is not known why so few young specimens have been secured; probably they are able to hide themselves better than the adults, which never make any such attempt.

Remarks.— Reminds one somewhat of *H. edulis* Lesson from the Indo-Pacific Ocean, both in outer shape and coloration, but *H. edulis* has a thinner skin which contains but few deposits, and among these the tables are more slender, lacking disk and vertical spines on top; the plates are also smaller and seem never to form biscuit-shaped plates.

Holothuria grisea Selenka

Plate **5**, figs. 1–4

Holothuria grisea Selenka, 1867, p. 328, p. 18, figs. 52–56. Semper, 1868, p. 92, 251. Greeff, 1882, p. 118. Ludwig, 1882, p. 26. Lampert, 1885, p. 85. Théel, 1886, p. 214. Clark, 1901b, p. 258; 1919, p. 63. Deichmann, 1926, p. 15.

Not *Holothuria grisea* Sluiter, 1910, p. 333.

?*Holothuria unicolor* Selenka, 1867, p. 329, pl. 18, figs. 63–64.

About 30 specimens examined.

A very characteristic form which may easily be recognized by its external characters, even if it is only 2 cm. long. Maximum size seems to be about 25 cm. Resembles somewhat *H. floridana*, but has a greater number of cylindrical feet on ventral side where the appendages form a regular sole; dorsal papillae arranged in series, 4 series in young specimens, 6 in very large ones and, generally, these papillae are placed on very distinct warts; small pedicels are placed in a circle around base of wart. Mouth directed slightly downward, with 20–25 yellow tentacles. Integument of medium thickness and of same texture as that of *H. floridana;* color in alcohol more or less dark grey, with minute white spots which are due to the accumulation of spicules in body wall. Tentacles and ventral feet honey yellow, sometimes the tip of pedicels may be darker brown. A few, very large specimens are very dark, like the young (which are rarely collected), and an occasional large individual may be pale, but, as a rule, this wide-ranging species is very constant in coloration, when alcoholic specimens are considered. (In life this species may be a complete harlequin with bright red and yellow colors (W. K. Fisher)).

The internal anatomy is very near that of *H. floridana* and *H. mexicana*, except that there is only one Polian vesicle and one stone canal, the latter is free with oblong head, dorsally placed, and contains very little calcareous matter.

Deposits.— Scattered tables, on an average shorter than those found in the above-mentioned species (height about 0.04–0.05 mm.), as a rule with about 12 spines on the margin of the small disk; the spire ends

in 12 teeth like those found in the two preceding species, but they are generally shorter; the tables seem not to change during growth, they are of exactly the same type in the smallest and largest specimens.

The inner spicules, which are collected in very distinct heaps, are regularly shaped plates with two or four central holes and sometimes smaller holes arranged at the ends and with a series of blunt teeth around the margin; a few plates are larger, more like rods, and some may be incomplete and thus resemble rosettes, but the deposits are absolutely larger than those of the two preceding species (diameter of plates about 0.05 mm.).

In the pedicels few, almost straight, supporting rods with a few holes in the spinous ends and a well-developed end plate; in papillae slightly curved, almost unbranched but spinous rods; in tentacles short, cylindrical rods, with unbranched or slightly branched ends and with spines along their sides.

Type locality.— Haiti.

Type in Museum of Comparative Zoölogy, cat. no. 620.

Ranges from Lesser Antilles (common) down to Curaçao, Colombia, and even as far west as Colon, Panama. Also known from southern Brazil. A single specimen has been reported from Florida; also known from Jamaica and Porto Rico. Also reported from Sao Thomé and Rolas, west coast of Africa, by Greeff, 1882.

It is very likely that this species is identical with *H. unicolor* Selenka, from Barbados; a few plates may resemble the figure which Selenka gives, and this holds also for the curved spinous rods, apparently from dorsal papillae, which Selenka describes as occurring in the dorsal integument.

The specimens which Sluiter has listed as *grisea* from the West Indies are, at least partly, *floridana*.

Actinopyga Bronn 1860

(*Actinopyga* Bronn, partim, and *Mülleria* Jaeger partim)

Diagnosis, after Pearson, 1914, p. 169.— Generally 20 tentacles, but occasionally more. Ambulacral appendages papillae on the bivium and pedicels on the trivium, the former being scattered and the latter being usually arranged in three more or less distinct rows. Anal teeth present. Calcareous ring has well-marked beveled ampullary notches, and the anterior border has no deep indentation between the radials and interradials. The radials extend almost as far forward as the interradials. Spicules small, generally taking the form of dichotomously

branched rods or spinous rods, or both. Tables and buttons never present.

(About rejection of the name *Mülleria*, see Fisher, 1907, p. 644, in the footnote.)

Only one species is known from the West Indian region, namely

Actinopyga agassizi (Selenka)

Plate 5, figs. 21–29

Mülleria agassizi Selenka, 1867, p. 311. Théel, 1886, p. 202. Lampert, 1885, p. 98.

Actinopyga agassizi Verrill, 1867–71, p. 347, Sluiter, 1910, p. 333. Crozier, 1917, p. 405.

About 15 specimens examined

Maximum size seems to be about 20 cm. A very robust form with thick leathery skin and numerous cylindrical appendages, arranged in 3 bands on ventral side, and small papillae or papilliform pedicels on dorsal side. Mouth ventrally directed with 25–29 broad tentacles; anus terminal with a round opening wherein are 5 large, white calcareous teeth, radial in position; the area around anus is devoid of other appendages. Skin very thick and firm. Color variable, from almost uniform brown to mottled yellow and different shades of brown in very diverse patterns. The pedicels seem invariably and the tentacles mostly to be yellow.

Internal anatomy.— A broad calcareous ring, of loosely united calcarious matter; radials and interradials of almost equal height and with more notches anteriorly than usual on account of the larger number of tentacles and tentacle ampullae; 1 or 2 Polian vesicles and one stone canal with rounded head, embedded in dorsal mesentery. Intestine unusually long; the course is not easy to make out, but apparently it follows along dorsal midline and then closely along right dorsal muscle band till it almost reaches the cloaca; then it turns forward and backwards in a secondary loop, and then in an oblique direction across the two left muscle bands, almost to anterior end of the animal, and then across the midventral muscle band and, after having formed a short arch toward the right ventral muscle band, it proceeds along the middle of right ventral interambulacrum. The intestine is very much convoluted in the posterior part of the first loop and in the third loop.[1] Respir-

[1] The course of the intestine is very much like that which Ekman, 1925, figures for *A. mauritiana*; apparently these secondary attachments form generic characters. The exact course is, however, difficult to make out, as the intestine in most captured specimens is often incomplete, and the internal layer of the body cavity easily tears off in flakes together with the mesentery.

atory trees very bushy, with wide stems and long much-branched secondary branches, the left one entangled in the large-meshed rete mirabile. A tuft of delicate, slender Cuvierian organs seems to be present at base of left tree. Genital organs present as tubules, 1 or 2 times divided, and attached in a tuft behind calcareous ring.

Deposits.— Only short rods and rosettes, usually rather simple and not very numerous. Dorsally the rods are relatively much branched, ventrally they are mostly present as simple rods, although rosettes may be present too. In pedicels a well-developed end plate and some elongate perforated rods near the end plate; also some few dentate rods and cross-shaped bodies and a few somewhat more complicated rosettes; in tentacles large, rough, simple rods and smaller, curved spinous rods.

Remarks.— It has been suggested by Théel that this form is identical with *A. mauritiana* (Quoy and Gaimard), from the Indo-Pacific Ocean. The forms are undoubtedly closely related, but it was evident even to Selenka that the spicules were distinctly different; in the West Indian form he found that they are much more simple than in any other known species, an observation which I have been able to confirm.

Type locality.— Florida.

Type in Museum of Comparative Zoölogy, cat. no. 795.

This species seems, as far as the collections give evidence, to occur only among the islands of the West Indies, from Barbados to Florida; a single specimen has been taken by Crozier in Bermuda, but it seems not to belong naturally to the fauna of that island, as it has never been recorded since.

STICHOPODIDAE Haeckel

Diagnosis.— Aspidochirote Holothurians, with tentacle ampullae, and genital organs in two tufts. Seem to have an intermediate position between the Holothuriidae and Synallactidae.

Clark, 1922, p. 47, 48 suggests the division of the family into 4 genera, namely *Thelenota*, *Astichopus*, *Stichopus* and *Parastichopus*. Only two genera are known from the western Atlantic.

Key to the genera from the Western Atlantic

1. Tables present, also C-shaped bodies; Polian vesicle simple.
Stichopus Brandt
1. No tables; granules in groups, accompanied by small S or C-shaped bodies.
Astichopus Clark

Stichopus Brandt 1835

Diagnosis, essentially from Clark, 1922, p. 44. Aspidochirote Holothurians with flattened ventral surface markedly distinct from dorsal, pedicels more or less fully covering ventral side; dorsal side with tubercles or papillae, at least along lateral margins; tentacles typically 20; gonads in a tuft on each side of dorsal mesentery; no Cuvierian organs; no anal teeth or noticeable papillae around cloacal opening. Numerous calcareous tables in epidermis; Polian vesicles few, unbranched; madreporic canal single.

Type species.— *Stichopus chloronotus* (Brandt).

Two species are definitely known from the West Indies; they are easily distinguished when the C-shaped bodies are examined.

Key to the two species

1. C-shaped bodies small, about as long as the tables are high (0.06 mm.), tables mostly with complete series of holes around four small central holes; skin thick; color very variable; size up to about 20 cm.
S. badionotus Selenka

1. C-shaped bodies large, about twice as large as the tables are high (about 0.1–0.15 mm.); tables with four marginal holes around four large central holes; skin thin; color pale brownish; size up to 12 cm.
S. macroparentheses Clark

Stichopus badionotus Selenka

Plate 5, figs. 30–36

Stichopus badionotus Selenka, 1867, p. 316, p. 18, fig. 26. Théel, 1886, p. 196. Clark, 1922, p. 55, pl. 2, fig. 11–18.
S. haytiensis Semper, 1868, p. 75, pl. 30, fig. 5.
S. möbii Semper, 1868, p. 246, pl. 7, fig. 11.
S. errans Ludwig, 1875, p. 97.
S. maculatus Greef, 1882, p. 158. Sluiter, 1910, p. 333.
S. diaboli Heilprin, 1888, p. 312.
S. xanthomela Heilprin, 1888, p. 313. (*S. acanthomela*, Zool. Rec., 1900, p. 78 (err. typ.)).

About 30 specimens examined

Maximum size about 20 cm., in life up to about 30 cm. A broad flattened form, with 3 rows of crowded cylindrical appendages on ventral side; the middle row being twice as broad as the lateral rows. Dorsally low warts. Mouth ventrally directed, with about 20 broad tentacles, and a large tentacle collar. Skin thick, especially laterally.

Color very variable, from buff to almost black, and all gradations of spotted specimens are found, often together. The ventral side is usually paler. Internally a broad calcareous ring, one Polian vesicle and one stone canal, attached to the dorsal mesentery. The tentacle ampullae are large. Intestine has the normal course; cloaca large; respiratory trees very bushy; the left being entangled in the richly developed rete mirabile. Genital organs typically developed, consisting of one long stem on each side of dorsal mesentery and with lateral, several times divided branches; the reproductive organs originate just behind the vascular ring.

Deposits.— A closely packed layer of small tables, with small disk, usually with a complete series of small marginal holes around 4 still smaller central holes; occasionally we may find some with 4 large central holes and 4 small marginal holes, but this type, predominant in very small specimens, is soon replaced by tables with complete series of outer holes. The spire is cylindrical, with two cross beams and a variable number of small teeth on the truncate top. In ventral appendages the spire is usually very low, although well developed.

A variable number of C-shaped bodies is usually found in the deeper layer of the skin, often near the dorsal appendages, but they are not always observed. Selenka missed them in his type specimen from Florida, although they are present in the specimen in question. The C-shaped bodies are a little longer than the tables are high or the disk is broad (about 0.06 mm.).

In pedicels we find a large end plate and numerous almost straight rods which in smaller specimens are simple, but in older become broadened out at the middle, with numerous perforations, so that they are ultimately transformed into broad, perforated plates.

In the tentacles we find large, curved rods with pointed ends and spines on their outer side.

Remarks.— This species is very closely related to *S. fuscus* from the Pacific Ocean, and Selenka mentions specimens from Acapulco, Mexico as belonging to *S. badionotus.* It differs only in very minute proportions of the spicules, which are slightly larger and heavier, with smaller disks in the tables and more plate-like supporting rods in the species from the Pacific Ocean. The color of *S. fuscus*, which is quite common in Panama, is more uniform, either reticulated brown or uniform brown. It is a remarkable fact that we have a form so closely related to the Caribbean form, which is known only from the west coast of tropical America; it is not likely that so large and conspicuous a species would have been overlooked in other parts of the Indo-Pacific Ocean.

The type locality for *S. fuscus* Ludwig (1875) is Patagonia, but I feel rather sure that this is an error. The very clear description which Ludwig gives applies in every respect to the specimens of *S. badionotus* from Acapulco, and to the numerous specimens which Dr. Mortensen has collected at Taboga, Panama. The occurrence of a typical species of *Stichopus* in Patagonia is highly improbable.

As is stated under *S. macroparentheses*, the latter form is also closely related to *badionotus*, only differing in its much larger C-shaped bodies and the more primitive form of the disk of the tables, as well as the more slender form of the spire.

Type locality.— Florida.

Type in Museum of Comparative Zoölogy; cat. no. 509.

Distributed over most of the West Indian Seas, from Bermuda to Panama, but according to H. L. Clark, not known from any locality south of Antigua, where it is quite common; very common in Bermuda.

It is usually regarded as a fact that it also occurs in the West African region; described by Greef as *S. maculatus*.

Occurs on soft, shady bottom, often in eel grass. The transparent young hide themselves among rocks; the larger specimens, from about 15 cm. long up, seem never to hide themselves and, according to Crozier, no animals will eat them. Their variable coloration seems to be merely an incidental feature, and is probably not protective.

A variety, *S. b. phoenius* Clark, is described (1922, p. 60) from Tobago; it seems to differ only in its beautiful red color, but it may be that it can be kept as a distinct variety, as this coloration is totally different from that of all other specimens.

Stichopus macroparentheses Clark

Plate **5**, figs. 37–43

Stichopus macroparentheses Clark, 1922, p. 61, p. 1, fig. 1–7. Deichmann, 1926, p. 21.

Five specimens examined

This peculiar species is probably derived from the common form *S. badionotus*, and has been found in several localities in the West Indies. Hitherto only small specimens, about 12 cm. long at most, have been captured, but it might be that some of the large specimens of *badionotus*, upon more careful examination, would prove to be *macroparentheses*.

The species seems to agree in most outer features with *badionotus*,

but is, as far as the available collections show, uniformly pale brown and more thin walled. The inner organization seems to be quite identical.

Deposits.— Tables and large C-shaped bodies. The tables are characterized by having 4 large central holes and usually 4 outer smaller holes alternating with the inner, sometimes some still smaller, therefore accessory ones, but, as far as we know, never forming a complete outer circle of holes. The spire is cylindrical, but more slender than in *S. badionotus* and we find that the tables in the ventral feet also have a lower spire. The spire ends in a number of small spines and is flattened on the top.

The C-shaped bodies are about twice as large as they are in *badionotus*, varying from 0.1–0.15 mm. in length, thus being about twice as long as the tables are high, or the diameter of the disk is wide.

In the feet we find a well-developed end plate and numerous rods, mostly straight with pointed or branched ends and sometimes vertically projecting arms near the middle which may unite and give rise to holes. In the tentacles, curved spinous rods.

In very young specimens, 2–3 cm. long, the tables are more delicate, but the large C-shaped bodies are present. Even if these deposits are not found in the preparation, we can distinguish between young of *badionotus* and *macroparentheses,* as the spicules in the former are slightly larger, and some of the typical tables, with a complete circle of holes, are usually found.

Type locality.— Montego Bay, Jamaica (H. L. Clark).

Type in Museum of Comparative Zoölogy, cat. no. 921.

The species is also known from Antigua (W. K. Fisher) and Florida (H. L. Clark).

It seems to have a mode of life quite similar to that of *badionotus.* The types, 9 cm. long, were found among rocks; the specimens from Antigua, which were larger, were found in eel grass.

(Stichopus ecnomius Clark

Stichopus ecnomius Clark, 1922, p. 66, pl. 2, figs. 24–29.

The very remarkable small species, *Stichopus ecnomius* Clark, has, upon further study, proved to be devoid of normal tables, which probably had their origin from other preparations. The specimen contains only the very large deformed tables which H. L. Clark has figured, which bear some resemblance to the four-armed tables in the Synallactidae. There are, moreover, some X-shaped bodies, and, in the

pedicels, end plates. It is impossible to determine the generic position of this specimen, but it is interesting, because it is probably the smallest specimen of any aspidochirote Holothurian which has ever been described, and it may be that these "abnormal" tables are quite normal for young specimens belonging to this group.)

ASTICHOPUS Clark, 1922

Diagnosis.— As in Stichopus, except for the complicated, branched Polian vesicles, and entirely different spicules; only minute granules collected in heaps and accompanied by small C, S or O-shaped bodies. No supporting rods; dorsally only small appendages; no thickened marginal brim.

Type species.— *Astichopus multifidus* (Sluiter).

ASTICHOPUS MULTIFIDUS (Sluiter)

Plate 5, figs. 44–47

Stichopus multifidus Sluiter, 1910, p. 334, fig. a-b.
Astichopus multifidus, Clark, 1922, p. 48.

One well-preserved specimen about 20 cm. in length examined, but fragments of another specimen are present in the Museum of Comparative Zoölogy, which indicate that this species may attain a length of at least 45 cm.

Outer aspect holothurian-like, with numerous, cylindrical, soft ventral feet and numerous smaller dorsal appendages, either papillae or papilliform pedicels. Twenty-one tentacles with rounded, knob-like disk are present, ventrally directed, surrounded by a very narrow tentacle collar; anus subdorsal. Color mottled brownish, with pale ventral side and tentacles.

Internally a loosely united calcareous ring, the exact shape of which could not be made out; tentacle ampullae very long and slender; 2 long, branched Polian vesicles, and others unbranched. A very small stone canal, embedded in dorsal mesentery. Intestine runs parallel to the right dorsal muscle band, almost reaching the large cloaca, then forward almost to the oral end along the lower side of the left dorsal muscle band, and then closely along the right side of the midventral muscle band. Respiratory trees relatively short, with wide stems and numerous short, finely divided branches; the left tree is as usual entangled in the very wide-meshed rete mirabile. Thin muscle bands with

free margin. No genital organs are developed in the specimen examined but according to Sluiter they are present as tufts, one on each side of the dorsal mesentery, of divided tubules.

Spicules.— Only small spherical grains, collected in heaps and small C, S or O-shaped bodies (length about 0.03–0.04 mm.). In pedicels an end plate, composed of several smaller plates, and numerous C-shaped bodies. In tentacles a few, straight, spinous rods, beside the C-shaped bodies.

Type locality.— Tortugas (Hartmeyer).

Type in Hamburg.

Known only from the type locality and from Port Antonio, Jamaica (H. L. Clark), but apparently very inconstant in its appearance, as Dr. Clark has sought it in vain on subsequent trips to the same locality.

SYNALLACTIDAE Ludwig 1894 [1]

Diagnosis.— Aspidochirote Holothurians without free tentacle ampullae; head of stone canal in most cases connected with the body wall.

Key to the genera which at present are known from the Atlantic Ocean

1. Deposits practically absent; genital organs in two tufts 2
1. Deposits present, usually quite numerous, developed as tables or derivates of these; genital organs in one or two tufts 4
2. Appendages very small; anus in a vertical furrow . . . . *Pseudostichopus* Théel
2. Appendages easily observable, at least most of them; anus as a rule not in a vertical furrow 3
3. Large marginal appendages and a double row of small feet in midventral ambulacrum . . . . *Benthothuria* Perrier [2]
3. Appendages distributed evenly over the back and sides, not especially enlarged along lateral margin; midventral ambulacrum and most of ventral interambulacra totally devoid of appendages . . . . *Paroriza* Herouard
4. Single tuft of genital organs 5
4. Two tufts of genital organs 6
5. Feet cylindrical, thread-like, numerous and of very variable size; deposits tables with short arms on top of spire; supporting rods absent in appendages . . . . *Mesothuria* Ludwig

[1] Herouard (1923, p. 30) places *Gephyrothuria* in this group, near to *Pseudostichopus*, because he thinks it contains numerous practically invisible feet. I have seen the type of *G. glauca* (Clark) and cannot confirm that observation. The genus seems to fit very well in the Molpadonia, where it was originally placed (see p. 193).

[2] Imperfectly known. It is unknown whether the absence of spicules is normal.

5. Feet wart-like, present only in the lateroventral ambulacra: deposits tables with very high and slender spire, with long arms on top of spire; supporting rods present in appendages. . . . . *Zygothuria* Perrier
6. Deposits four-armed bodies with high spire, composed of four rods and several cross beams; distinct ventral sole, with margin of numerous small appendages; odd ambulacrum usually naked or with a few irregularly distributed pedicels; often wart-like small appendages on the ventral interambulacra. . . . . *Bathyplotes* Oestergren
6. Deposits 3–4 armed rods with solid spire or no spire at all, or perforated plates with or without spire. 7
7. Flat, broad forms, with double rows of small appendages on posterior part of unpaired ambulacrum; deposits three-armed, with a few holes in the ends of the arms, no supporting rods. . . . . *Pelopatides* Théel
7. Cylindrical forms without distinct sole, no separate row in unpaired ambulacrum; ventral appendages of various shapes; supporting rods present . . 8
8. Skin leathery to gelatinous, with relatively few deposits, developed as three- or four-armed bodies, sometimes the arms united, thus forming disks with a solid spire. . . . . *Synallactes* Ludwig
8. Skin thin, glass-like, filled with deposits, representing various stages of tables, with small to very large disks, perforated by numerous holes; spire usually composed of 3 rods with 1–3 cross beams; in the larger deposits it is entirely reduced. . . . . *Amphigymnas* Walsh

Pseudostichopus Théel, 1882

Diagnosis, from Hérouard, 1923, p. 230.— Sixteen to twenty tentacles; no tentacle ampullae hanging free into the body cavity; stone canal connected with body wall, sometimes perforating it; in other species apparently absent. Ambulacral appendages cylindrical, or conical, small and numerous especially on the back and side of body, often distributed in pairs which gives the aspect of a serial arrangement. Genital openings placed on the boundary between the first and second third of body; genital organs forming two symmetrical tufts, one on each side of dorsal mesentery. Anal retractors originating from paired ambulacra alone, permitting the longitudinal muscle of the odd ambulacrum to contract the anal region into a deep furrow. Deposits rare or completely lacking.

Type species.— *Pseudostichopus mollis* Théel.

Key to the species of Pseudostichopus, which at present are known from the Atlantic Ocean

1. Body distinctly flattened, with a cartilaginous brim; head of stone canal visible as a large, kidney-shaped depression on dorsal side. Feet small, uniformly distributed. . . . . *Ps. depressus* Hérouard

1. Body not distinctly flattened and with only a very faint indication of a brim near oral end, or none at all; head of stone canal not visible as a kidney-shaped depression on dorsal side 2
2. Body covered with Creseis shells and sponge spicules; occurs at relatively slight depth, namely 400–600 m. . . . . *Ps. occultatus* v. Marenzeller
2. Body either covered with globigerinae, small stones or naked 3
3. Appendages small, very difficult to see; integument white, thick, no foreign particles adhering to it; an indistinctly thickened brim may be found around anterior end . . . . *Ps. atlanticus* Perrier
3. Appendages relatively large, often of various sizes 4
4. Pedicels very few, arranged only along the ambulacra; dorsally 4 pairs of feet, placed along inner side of dorsal ambulacra anteriorly; laterally a series of feet, placed on each side of the ventrolateral ambulacra and most numerous on ventral side; posteriorly they are larger and united by a kind of webbing; in odd ambulacrum an incomplete row of very small pedicels . . . . *Ps. lapidus* Hérouard
4. Pedicels numerous, distributed over almost the entire surface 5
5. Pedicels ventrally few, beside the lateral which are large and placed in an indistinct series, at some distance from the margin there are regularly distributed small appendages arranged in heaps, most numerous near oral end and in the posterior third of the ventral side; body covered with globigerinae . . . . *Ps. marenzelleri* Hérouard
5. Pedicels ventrally numerous 6
6. Pedicels ventrally of unequal size, near osal end placed on low warts; dorsally numerous; anus placed on a small, conical prominence; body covered with globigerinae . . . . *Ps. globigerinae* Hérouard
6. Pedicels numerous on ventral side of equal size; general aspect hairy. *Ps. villosus* Théel

Pseudostichopus atlanticus Perrier

Pseudostichopus atlanticus Perrier, 1901, p. 333, pl. 17, fig. 15–20.

One specimen, 9.5 cm. long, is at hand; body much flattened, like an empty sack, mouth ventral, surrounded by 20 tentacles; anus in a deep furrow. Appendages extremely difficult to observe, but I believe that they are mostly arranged along the ventrolateral ambulacra and below anus. The integument is opaque; around the oral end there is an indication of a marginal thickening. Color whitish; the ventral midline gray; tentacles dark brown.

Internally almost all organs are ejected. A well-developed calcareous ring deeply excavated and undulated. No stone canal could be traced; one well-developed respiratory tree with numerous small tufts of secondary branches; muscle bands narrow, of equal size, undivided, circular in cross section.

Spicules.— No spicules could be detected in any part of the body, but it is possible that the alcohol contained some acid; the specimen examined has been kept in alcohol since 1879.

Type locality.— Between Azores and France, depth 3614 m.

Type in Paris.

The specimen examined is from off Bequia, British West Indies; depth 2,920 m.; coll. Museum of Comparative Zoölogy

Remarks.— The specimen seems to agree best with Perrier's *Ps. atlanticus* in the total absence of adhering particles. The presence or absence of spicules in these forms is always a somewhat problematic character, as they may be variously developed in specimens of different ages.

Perrier thinks that Théel's specimens of *villosus* from between Bermuda and France are identical with *Ps. atlanticus;* I cannot agree with him, as the hairy aspect seems to be such an important character, and the appendages in *Ps. atlanticus*, according to the description, are very small, retracted and not hairlike. I am more inclined to think that Hérouard's *Ps. villosus* from off Morocco is identical with *Ps. atlanticus*. Hérouard gives a figure of a perfectly smooth animal, and the figure of the calcareous ring resembles very much that of the specimen which I have examined.

Pseudostichopus depressus Hérouard

Pseudostichopus depressus Hérouard, 1902, p. 15, p. 2, fig. 15–18. Perrier, 1901, p. 337.

Fourteen small specimens, up to 8 cm. in length, seem to belong to this species; they are very flat, with a broad, cartilaginous brim; mouth ventrally directed, anus in a very distinct furrow. The attachment of the stone canal is visible on outer side; appendages are visible in a broad band along midventral ambulacrum, where they are quite distinct; if appendages are present on other parts of the integument they are extremely small. Color white; integument cartilaginous, especially in the small specimens.

Internal anatomy quite typical, midventral muscle band broadest. No deposits have been detected in any part of the body.

Type locality.— Between Portugal and Azores; depth 4,360 m. The specimens described are from off the coast of South America, "Albatross" station 2,127. In United States National Museum.

Pseudostichopus villosus Théel

Pseudostichopus villosus Théel, 1886, p. 170. Hérouard, 1902, p. 11, pl. 2, fig. 1–3; pl. 7, fig. 3; 1923, p. 23.

Three specimens, from 2–3 cm. in length; after having been placed in fresh water for twenty-four hours the feet were distinctly expanded; these are laterally placed in bundles on distinct conical warts; ventrally the feet are uniformly distributed and dorsally they seem to be scarce and smaller. The tentacles are large and not much ventrally directed; anal furrow not very deep. Color golden brownish.

Internally a very delicate low calcareous ring; one ventrally directed Polian vesicle; no stone canal could be detected. Intestine partly lost; only one respiratory tree is left; muscle bands of equal breadth; genital organs as thick finger-like tubules divided once, and apparently placed near middle of body cavity, but that may be artificially.

No deposits could be detected.

Type locality.— Latitude 34° 53′ N.; longitude 56° 38′ W.; depth 2,652 m.

Type in British Museum.

Also from several stations in the Pacific Ocean.

The specimens here examined are all from off Guadeloupe, French West Indies; depth 896 m.

Remarks.— Seems to be identical with Théel's species, except for the absence of the mulberry-shaped deposits which Théel himself thought were artificial. The species is, as noted above, recorded from the Indo-Pacific Ocean; comparison of these specimens from different localities will probably give unsatisfactory results; most likely we have a case similar to that of *Cucumaria abyssorum* Théel, namely, one species which gradually changes into closely related forms or varieties.

Pseudostichopus occultatus v. Marenzeller

Pseudostichopus occultatus v. Marenzeller, 1893, p. 15, pl. 4, fig. 9.
Not *Pseudostichopus occultatus* v. Hérouard, 1902, p. 14, pl. 2, fig. 4–14.

A single specimen examined, hardly 2 cm. in length, completely covered with sponge spicules and Creseis shells, which gives it an aspect as if it were covered with silk-like spines; anal furrow seems to be present, but it is very difficult to make out; mouth ventral with very small, almost tubular tentacles, the exact number could not be determined. Body wall paper thin, soft, with long thread-like appendages along the ambulacra and smaller ones on interambulacra (only a small

part of the shell covering was removed). Internally a low, very fragile calcareous ring and two bundles of well-developed genital tubes, containing ripe eggs and originating near the oral end; muscle bands simple, undivided. All other organs lost.

Deposits.— In tentacles, small curved supporting rods, most of them provided with a thickening at the middle; in appendages and body wall all deposits were missing; genital organs contain numerous delicate, much branched rods, much more complicated than in the type specimens.

Type locality.— Eastern Mediterranean Sea (Pola); depth 745–2,180 m., also reported from coast of Spain (l'Hirondelle).

The present specimen is from off Havana, Cuba, depth 232 m.

Remarks.— The reason why I think this specimen belongs to v. Marenzeller's species is the relatively slight depth at which it was taken; it seems, as Hérouard points out in 1923, quite constant that this species lives at a shallower depth than the other species of the genus; its choice of the material with which it covers itself very likely also depends upon the depth; Creseis shells and sponge spicules are not available at the very great depths where globigerinae serve as protective coverings.

PSEUDOSTICHOPUS LAPIDUS Hérouard

Pseudostichopus lapidus Hérouard, 1923, p. 26, pl. 4, fig. 5.

Type locality.— Between Azores and North Africa; depth 3,676 m.

Not known from the western part of the Atlantic Ocean.

PSEUDOSTICHOPUS GLOBIGERINAE Hérouard

Pseudostichopus globigerinae Hérouard, 1923, p. 23, pl. 4, fig. 6.

Type locality.— Bay of Biscay; depth 4,588 m.

Most probably identical with Théel's *Ps. villosus.*

Not known from the western part of the Atlantic Ocean.

PSEUDOSTICHOPUS MARENZELLERI Hérouard

Pseudostichopus marenzelleri Hérouard, 1923, p. 25.
Ps. occultatus Hérouard, 1902, p. 14, pl. 2, fig. 4–14.

Type locality.— Between Azores and Portugal; depth 4,423 m.

Not known from the western part of the Atlantic Ocean.

BENTHOTHURIA Perrier 1901

Diagnosis, translated from Perrier, 1901, p. 365.— Twenty tentacles; stone canal penetrating the body wall; body with well-defined sole, surrounded by a continuous series of conical papillae, which forms a very distinct border; on the ventral side, a double series of pedicels along the odd ambulacrum on the posterior two thirds of the body; besides these a double series of lateral pedicels placed on the posterior third part of the body in the ventral interambulacra. Dorsally irregularly distributed ambulacral and interambulacral papillae. Two tufts of genital organs. Deposits absent (dissolved or normally lacking?).

Type species.— *B. funebris* Perrier, 1901, p. 365.

Only the type species is known at present. It was taken off Sudan, Senegal, from a depth of 782–1,230 m. (Talisman). Perrier gives a very detailed description of this remarkable form which seems to be most closely related to *Pelopatides*.

It may possibly be found in the West Indian seas.

MESOTHURIA Ludwig 1894

Diagnosis, as modified by Perrier, 1901, p. 301.— Twenty, rarely 18–19 tentacles; no tentacle ampullae; stone canal attached to body wall without penetrating it; ventral side usually somewhat flattened; dorsal side more or less uniformly covered with numerous pedicels, which are small and of equal size, or much smaller dorsally, where they sometimes are hardly visible. Single genital tuft, placed to the left; anus ventral or subventral, without special arrangement; calcareous deposits present in body wall and pedicels (except in *M. expectans?*), developed as tables exclusively, either tri- or quadriradiate; no supporting rods in pedicels.

Type species.— *Mesothuria multipes* Ludwig.

Key to the species known from the Atlantic Ocean

1. Two series of large papillae in each ambulacrum, except in the odd; the remaining part of body covered with numerous small appendages which are smallest ventrally and larger dorsally and laterally. Deposits absent or dissolved . . . . *M. expectans* Perrier
1. No series of large papillae; pedicels of equal or unequal size 2
2. Deposits quadriradiate tables 3
2. Deposits triradiate tables 5

3. Feet, thin, thread-like, of almost equal size, distributed over the entire surface except on anterior part of ventrum. Deposits as tables with irregular margin and relatively small rectangular holes, often with disk incompletely developed; spire low, ending in 4 simple teeth; in pedicels the tables are reduced to spires alone; end plate small, especially in dorsal appendages . . . . *M. verrilli* Théel
3. Feet small dorsally, absent partly or entirely on ventral side 4
4. Deposits, tables with about 8 marginal holes of equal size, oval in outline, sometimes accessory holes in variable number; spire ending in a variable number of small teeth; in feet, tables with well-developed disk; large end plate in lateral feet, smaller in dorsal appendages; only rudimentary appendages present on ventrum . . . . *M. intestinalis* (Ascanius and Rathke)
4. Deposits, tables with enormous disk with numerous holes, in several circles, the innermost being the largest; spire ending in numerous teeth; end plate absent in most cases; sexes separate . . . . *M. gargantua* n. sp.
5. Pedicels distinctly larger along the sides; ventrally rudimentary, dorsally quite good-sized; tables regular, triradiate, usually with 6 large holes; spire relatively low, with short diverging arms on top, ending in a few small teeth; tables smaller but usually well-developed in appendages. *M. maroccana* Perrier
5. Pedicels hair-like, very uniform in size, absent on interradialia; tables with irregular perforated disk; spire high, slender; arms almost parallel and often of unequal length, ending in a few teeth; in the feet, tables high without disk and often distinctly deformed as are some of the tables in body wall . . . . *M. rugosa* Hérouard

Five species have been taken in the western part of the Atlantic Ocean.

Mesothuria expectans Perrier

Mesothuria expectans Perrier, 1901, p. 317.

Only one specimen 9.5 cm. in length has been recorded; from its anatomy it is a typical *Mesothuria*, but it is absolutely devoid of spicules. It is characterized by having slender papillae situated along the sides beside normal cylindrical feet, which are small ventrally and large dorsally and laterally.

The type had one tuft of small genital organs developed on the left side. Perrier is of the opinion that Hérouard's *Paroriza prouhoi* is possibly identical with *M. expectans*, but the genus *Paroriza* is characterized by its two tufts of genital organs; it may be that the genital organs are developed later and are feebler on the right side in *Paroriza;* if this is the case *M. expectans* will quite naturally be removed from the genus *Mesothuria* and placed in *Paroriza*.

Type locality.— Between Azores and France; depth 4,255 m.

It may be expected to occur in the West Indian seas.

Mesothuria verrilli (Théel)

Plate 6, figs. 1–8

Holothuria verrilli (partim), Théel, 1886a, p. 6. Marenzeller, 1893, p. 7, pl. 1, fig. 2; pl. 2, fig. 2. Oestergren, 1896, p. 345. Perrier, 1901, p. 307, pl. 15, figs. 22–31.

Mesothuria intestinalis Koehler, 1896, p. 106. Ludwig, 1901, p. 138.

Allantis intestinalis var. *verrilli* Hérouard, 1902, p. 18, pl. 1, figs. 3–6.

Not *Mesothuria verrilli* Deichmann, 1926, p. 22, pl. 1, fig. 2 (young Holothuria sp.).

Several specimens varying from 2–30 cm. were examined. The species is, when well expanded, a cylindrical form with relatively thick skin, the outer layer often much wrinkled as if it was an outer covering of silk; appendages very small, thread-like, and in large specimens very hard to observe, except near the ends, especially on the ventral side near anus; they are uniformly distributed, being absent only on the anterior part of ventrum. Mouth ventrally directed, with about 20 relatively small tentacles which usually are retracted; anus terminal.

Internal anatomy as in other species in this genus; the most striking feature being that the genital organs are different in male and female; in the former they are relatively long tubes resembling the genital tubes in *M. intestinalis;* in the latter they are very short, grapelike; they are quite numerous and of variable size; in dissected ripe specimens I found that the posterior part of the genital basis has small, partly absorbed genital tubes, whereas the anterior portion has small, unripe tufts, containing immature sexual products of the same kind as that of the large, ripe tufts.

The deposits are numerous tables with irregular or regular disk, according to the age of the specimen; the disk is partly resorbed during life; it has a large central hole and about 8 marginal holes, smaller alternating with larger, and almost squarish in outline; spire usually low with 4 simple teeth on top. In feet a small end plate is usually present and a number of small tables with the disk resorbed and often also a partly resorbed spire. (Diameter of disk about 0.08–0.09 mm.; height 0.06 mm.)

In some of the smaller specimens we find tables with much larger disk (diameter 0.11 mm.), larger holes and higher spire, often with a small thorn-like spine beside the typical simple teeth; in the feet we find tables with complete disk.

Type locality.—Off Ambergris Key, British Honduras; depth 1,200 m. Type in Museum of Comparative Zoölogy, cat. no. 448.

Also from off Barbados, Dominica, Grenada and other localities in the West Indies.

Also correctly recorded from the following localities: Mediterranean Sea and Azores (v. Marenzeller, Hérouard), several stations along coast of Sahara (Perrier).

Depth.— From 700 m. and downwards.

Remarks.— Three species were united by Théel under the name *M. verrilli*, namely *intestinalis*, *gargantua* and *verrilli;* Théel's description refers partly to the two last species and it has been most natural to select the name *M. verrilli* for the species which was recognized later under that name by v. Marenzeller, Perrier and others. The species has been united with *M. intestinalis* (Ludwig, Koehler, etc.) and it was v. Marenzeller who, in 1893, gave the distinguishing characters between *verrilli* and *intestinalis;* later Perrier (1901) added some other characters.

The distinguishing features are the small feet of equal size, with small end plates and small abortive tables, the form of the holes in the disk, the simple teeth on top of spire, and the sexes separate, with difference in the shape of the genital tubes.

Mesothuria intestinalis (Ascanius and Rathke)

Plate 6, figs. 9, 10

Holothuria intestinalis Ascanius and Rathke, 1867.

Mesothuria intestinalis Ludwig, 1901, p. 139 (complete list of references, partly obsolete). Perrier, 1901, p. 204, pl. 16, figs. 19–21, text figs. 1–2. Théel, 1902, p. 4–34, pl. 1, 2, figs. 1–19, and 12 text figures.

It is with much doubt that I include the typical north Atlantic form in the West Indian fauna, especially as a closely related form, *M. gargantua*, occurs in these waters, but I have compared specimens of the same size with each other, and I feel very sure that they are different.

Three specimens examined, ranging in size from 6–12 cm. and in outer shape quite identical with others from Norway which I had at my disposal. They have the peculiar semitransparent skin to which a few pebbles cling, the same arrangement of the appendages with large lateral feet, smaller dorsal ones and almost completely naked underside. It has sometimes been stated that the dorsal side is almost naked, whereas the ventral side is provided with appendages; in all the specimens which I have seen this is not the case, the dorsal side has feet and the ventrum is almost naked.

The internal anatomy is not peculiar, and has been described by several writers. A low simple ring of the common "holothurian-like

type," a single Polian vesicle and a dorsal stone canal attached to the integument; a relatively short muscle stomach, usually mud-filled intestine, the first loop attached in dorsal interambulacrum, the second below left dorsal muscle band, the third in right ventral interambulacrum, nearest the median muscle band; two large free respiratory trees with large lobes; muscle bands undivided, of equal width; genital organs attached near oral end, of the usual type, with several large ducts ending in a number of divided tubes, the anterior tubes smaller and of a distinctly different color and containing the opposite kind of sexual products than the large tufts; posteriorly a well-developed genital basis with small brown spots, indicating the scars left by resorbed genital tubes; one specimen seems to be an almost ripe female; the large tubes are yellow and filled with eggs.

Deposits.— Exactly as in Norwegian specimens; well-developed tables with large central holes and about 8 marginal holes which are oval, usually with the outer end of the oval more pointed; accessory holes may also be present; the feet are filled with spicules of the same type and size, and there are also well-developed end plates with relatively dense network.

Type locality.— Coast of Norway.

Type not existing.

This species has to some extent been confused with *M. verrilli*, and it is at present impossible to give any exact account of its distribution. It seems to range from the coast of Norway to the Mediterranean Sea and coast of North Africa (Talisman). It is said to range from 18 to about 1,000 m. in vertical direction, and von Marenzeller is undoubtedly right when he regards it as the shallow water form, whereas *M. verrilli* is the deep water form, although it must be remembered that the latter also occurs in a few hundred fathoms depth.

From the western part of the Atlantic Ocean I have examined 3 specimens, one from Grenada, depth 748 m., and two from "Fish Hawk" station no. 7,514, off Florida in 200 fms.

Remarks.— The differences between this species and *M. verrilli* have been very carefully worked out by von Marenzeller and Perrier; they are also briefly mentioned above.

Mesothuria gargantua sp. nov.

Plate 7, fig. 1

Holothuria verrilli Théel (partim), 1886a, p. 6.

Several specimen of this species are at hand, varying in size from 7 to 20 cm. in length. The species resembles a very robust form of

M. intestinalis. Mouth ventral, surrounded by about 20 tentacles, which in all cases are retracted; anus terminal; appendages absent on the foremost part of ventrum and otherwise uniformly distributed over the entire body; they are stout, cylindrical, and of almost equal size throughout, perhaps slightly smaller on dorsal side; integument in the older specimens firm, rough to the touch; color white or yellowish.

Anatomy almost exactly like that of *M. intestinalis* but the genital organs which are shorter in *intestinalis* seem to contain only one kind of sexual products; the posterior part of the genital basis shows scars of atrophied genital tubes, but the anterior tufts, although they are small, are of the same kind as the large tufts placed on the middle of the stolon. One of the specimens was peculiar in that it had "viscera inversa," the intestine being attached in the opposite interambulacra (except the dorsal loop), and the genital organs being attached on the right side of the mesentery.

Deposits.— Very large tables (diameter up to 0.25 mm.), most of them being 2–3 times as wide as the tables found in *M. intestinalis;* with about 8 inner holes which are oval in outline and become reduced in size in the larger tables; outside these we find a variable number of small holes arranged without any definite order; the spire is low, solid, with few to many blunt spines on top; a few tables with delicate meshwork and 8 large regular holes may be found; these are evidently juvenile tables which have not been resorbed yet.

The feet are covered with tables which are almost as large as those found in the body wall; I have in most cases failed to find any end plate; they seem to be few in the small specimens, and I believe that they are totally absent in the large specimens, where the end of the pedicel usually is contracted; in the tentacles a few large-meshed plates.

Type locality.— Off Barbados; depth 720 m.

Type in Museum of Comparative Zoölogy, cat. no. 449.

Also from off Dominica, and St. Vincent, 659 and 825 m. depth.

Remarks.— This large species differs from *M. intestinalis* in the much larger and more solid tables; the reduction of end plates, the presence of numerous large feet on the posterior part of ventrum, the larger size, and the fact that the sexes are separate (as far as the present material shows).

Mesothuria maroccana Perrier

Plate 7, figs. 2–7

Mesothuria maroccana Perrier, 1901, p. 312, p. 16, figs. 32–35. Hérouard, 1923, p. 17.
Holothuria murrayi ? Théel, 1886, p. 127.
Mesothuria verrilli Théel, 1886a, p. 6 (partim).
Mesothuria murrayi var. *grandipes* Hérouard, 1923, p. 15, pl. 4, figs. 7–9.
Not *Mesothuria murrayi* (Théel), 1886a, p. 6. Hérouard, 1902, p. 23.

The 7 specimens which I have examined are all 4–6 cm. in length, tapering, usually much contorted; mouth ventrally directed with about 20 small, violet tentacles; feet of unequal size, largest along the sides, where a zigzag or double row seems to be present; they are small but quite well developed on dorsal side, whereas they are quite vestigial on the ventrum.

Internal anatomy as in the rest of the group. Sexes separate.

Deposits.— Tables with 6 large marginal holes and quite large central hole; spire relatively low with 3 short rods, a single cross beam and greatly diverging arms at the top which ends in a few small teeth; in the feet a small end plate and several tables of the same type as in body wall and also some which are devoid of disk; these resemble those of *M. rugosa*, but are not so high.

Type locality.— Coast of Morocco; depth 2,105 m.

Type in Paris.

Distribution.— From vicinity of Gibraltar (Théel, Perrier) to the West Indian seas.

In the Museum of Comparative Zoölogy there is one specimen from southwest of Jamaica, 999 m. depth.

In the United States National Museum there are specimens from "Albatross" stations: 2,379, 2,381, Gulf of Mexico; 2,658, 2,659, Bahamas to Cape Fear, and 2,751, off Cape Florida.

Remarks.— The present species was first described from Gibraltar by Théel as *H. murrayi?;* later Perrier gave a very careful description of it, and I think he is right when he regards it as a distinct species. I have had the opportunity to compare his description and figures with Théel's specimens in the British Museum, and I feel quite sure about their identity.

Hérouard's *M. murrayi* var. *grandipes* is, as far as I can see, identical with Perrier's species; the differences which Hérouard points out (p. 17) are, first the arrangement of the lateral pedicels in two rows instead of one, a very doubtful character when the variation caused by con-

traction or age is considered; second, the serial arrangement of the dorsal appendages, also a very doubtful matter; and third, the fact that the deposits are much larger than in Théel's and Perrier's species, the disk having a diameter of 0.15–0.18 by 0.10–0.12 mm. With our present imperfect knowledge of the variation within a single species, this character is not of supreme importance. It may be that *M. murrayi* var. *grandipes* is a specimen which has retained some of its larger,

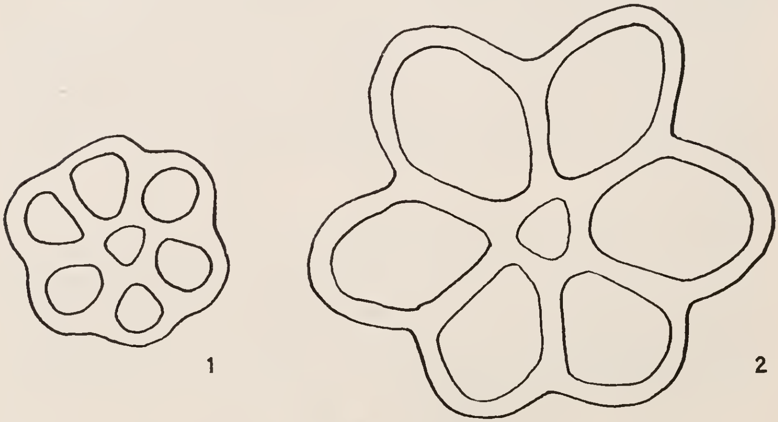


Fig. 1.— Outline of disk of table of Théel's *M. murrayi*, from Gibraltar.
Fig. 2.— Outline of disk of table of Théel's *M. murrayi* from the Pacific Ocean. (Same magnification.)

juvenile tables; it may be that it is really a distinct variety, but then it would be more correct to write *M. maroccana* var. *grandipes*. Hérouard does not mention what the deposits are in the feet, and he gives no figures of the deposits at all.

I have also had the opportunity to compare the Atlantic form with the Pacific form of this species; the tables in the latter species have another outline and are much larger, so I think it will be best to keep the two forms separate.

Mesothuria rugosa Hérouard

Plate 8, figs. 1–6

Mesothuria rugosa Hérouard, 1923, p. 19, pl. 1, figs. 11–21.
Holothuria murrayi Théel, 1886a, p. 6.
Mesothuria murrayi Hérouard, 1902, p. 23.

The 3 specimens examined are 4–6 cm. in length and their aspect is

hairy; the tapering body is almost uniformly covered with very thin pedicels; these are absent on some parts of midventral ambulacrum and according to Hérouard, who has examined one 16 cm. long, they are arranged in broad bands, being absent on the median part of the interambulacra, but this was not visible in the strongly contracted and contorted specimens which I had at my disposal.

The internal anatomy is not peculiar; the genital organs were ripe in the specimens examined; 3–4 large tufts, with short tubes, were present, placed on long ducts beside which there were also a number of unripe tufts.

Deposits.— Tables which in my specimens have a large disk with numerous triangular or rectangular holes; spire high, ending in 3 arms, often of equal size, parallel with the axis of the spire and with some small teeth on the ends; in the feet, typical small end plates, with a large perforation in the central part, and several small but high, deformed tables, usually without disk.

Type locality.— Near Cape Verde Islands; depth 3,890 m.

Type in Monaco.

In the West Indies, off Guadeloupe and St. Vincent (Théel).

Remarks.— The determination may be criticized inasmuch as several of the tables have a much larger and more complicated disk than those which Hérouard figures; but it is a well-known fact that the spicules vary very much in this genus and, as Hérouard's figures are from a specimen which is 16 cm. long, it is at least very likely that the species when young has much larger deposits; the general impression of the spicules, especially of those in the feet, is of something very deformed and irregularly developed.

A specimen from station 719 ("Princess Alice") is in the Museum of Comparative Zoölogy, listed as *M. murrayi*, but identical with the specimens of *M. rugosa*, which I have examined from the West Indian region. It has feet of almost equal size and very contorted, high tables, so there is no doubt about its identity. Hérouard undoubtedly overlooked this record of *M. murrayi* in his last paper, where he deals with *M. rugosa* and *M. murrayi* var. *grandipes*.

Bathyplotes Oestergren 1898

Diagnosis.— Synallactinae with 15–20 tentacles; mouth ventrally, anus dorsally; body with solelike ventral side, usually with marginal appendages; midventral ambulacrum naked or provided with a few feet; ventrolateral ambulacra with feet in a single row or more;

dorsally papillae, more or less distinctly in rows; musculature in most cases undivided; genital organs in two tufts; deposits, tables with cross-shaped disk and spire built up of four rods, usually with several cross beams; very closely related to *Synallactes*.

Type species.— *B. natans* (Sars).

The number of species known at present from the Atlantic Ocean is somewhat difficult to determine, as the specimens are often in very bad condition, and the descriptions of their outer shape are therefore somewhat diverse. The situation becomes especially difficult when the spicules have been dissolved, as has happened in some of the specimens from the West Indian region, and also in one of Perrier's specimens.

Key to the species of Bathyplotes at present known from the Atlantic Ocean

1. Calcareous deposits with relatively short arms; the ends perforated by several small holes; spire with parallel rods and usually strong spines on the sides; 3–4 cross beams which are distributed at almost equal distance from each other; fungiform papillae absent or, when present, very small. *B. natans* (Sars)
1. Calcareous deposits with relatively long, slender arms; ends perforated by few, large holes, often dichotomously branched; spire distinctly tapering, with small teeth or none on sides; cross beams only on upper part of spire; fungiform papillae large, in variable number (possibly sometimes absent?). *B. pourtalesi* (Théel)

BATHYPLOTES NATANS (M. Sars)

Plate 9, figs. 1, 2, 8

Holothuria natans M. Sars, 1868, p. 4.
Bathyplotes fallax Oestergren, 1896, p. 355.
Bathyplotes natans Ludwig, 1901, p. 137 (complete list of references).
Bathyplotes tizardi (Théel), Ludwig, 1901, p. 138, pl. 12, figs. 3–4; pl. 18, fig. 19.
Bathyplotes reptans Perrier, 1901, p. 352, pl. 12, figs. 3–4; pl. 18, figs. 1–9.
Bathyplotes natans Grieg, 1921, p. 7. Mortensen, 1924, p. 220, figs. 105, 106.
Not *Stichopus natans* Théel, 1886a, p. 5.

It is with some doubt that I include this Norwegian species among the West Indian forms, but specimens of this species seem to show so much variation that it is impossible, at present at least, to draw any sharp line between specimens from various localities, and the spicules seem to agree exactly.

The 5 West Indian specimens which have been examined are all

large, about 15–20 cm. in length, with a smooth vaulted dorsal side with small thread-like papillae scattered in indistinct longitudinal rows; the ventral sole is provided with a distinct fringe of small conical papillae. In all the specimens which I have had occasion to examine I have found a distinct midventral longitudinal furrow, provided with numerous small pores which resemble small contracted appendages, but examination of the inner side shows that there are no connections with the vascular system. In ventral interambulacra a number of small appendages are present which belong to the ventral side of the lateroventral vessels; they are few, arranged without order and almost devoid of deposits, but this may be due to age (in a much smaller specimen from Lofoten which I have used for comparison, the appendages form a distinct double row on each side and the appendages contain end plate and numerous supporting rods).

The color is pale yellowish or white; the contracted furrow is darker, dirty grayish. The skin is thick, opaque and finely rough from the deposits.

Internally there is a low calcareous ring, one slender Polian vesicle, a very small stone canal with indistinct head which attaches dorsally near the opening for the genital duct. The intestine is lost, its exact course could not be determined; respiratory trees are also lost. The muscle bands are broad and fleshy; the lateroventral ones are provided with a longitudinal furrow; the midventral band seems to be completely divided; the dorsal ones are simple and about twice as broad as the ventral bands. The genital organs are attached near oral end, about 1 cm. behind vascular ring; each tuft consists of a long duct which ends in a number of several short, divided tubes.

Deposits.— Of the same type as in the Norwegian form, with numerous small holes in the expanded ends of the arms, and a stout, not tapering spire with 3–4 cross beams and strong, blunt spines projecting from the sides; some of the spicules are much smaller than others, a normal condition in this genus. No C-shaped deposits were found. In feet a few supporting rods, no end plate; in tentacles numerous curved, simple rods.

Type locality.— Coast of Norway.

Type apparently not existing.

B. natans (with *B. tizardi* and *fallax*, both regarded as varieties, as they all occur in the same localities and gradually merge into each other, according to Dr. Th. Mortensen's observation) is the typical form from 60° to 69° latitude along the coast of Norway, at a depth of 183–1229 m., according to Ludwig (1901).

It may be that future investigations will prove that there really exist northern and southern subspecies and if that is true, it is very likely that the West Indian form will be placed in the latter subspecies.

When Perrier described his new species *B. reptans* from off Morocco, he figured the spicules of another specimen from off Senegal, and these spicules seem to agree with those found in *B. natans;* and I am inclined to think that *B. reptans* is identical with *B. natans*. Perrier mentions that the papillae are more numerous in his specimen of *reptans* than they are in *natans*, but it is very difficult to be sure of this character when the animals are much contracted, and in poorly preserved specimens of *natans* the dorsal appendages may look as if they were more conical in shape than in normal specimens. Perrier also mentions that small fungiform papillae are present on the ventral side beside the typical pedicels; in the Norwegian specimen at my disposal I found the same kind of small milk-white knobs along the ventral side; as far as I know, these appendages have never been noted before in the typical form, but they are very inconspicuous; they seem not to be present in the specimens from the West Indies.

From the West Indian region *B. natans* is represented from the following "Albatross" stations: station 2,396, 1 specimen; station 2,398, 5 specimens, all in United States National Museum.

As stated above, Théel's *natans* from St. Kitts is not *B. natans* but a poorly preserved specimen of *B. pourtalesi*.

Bathyplotes pourtalesi (Théel)

Plate **9**, figs. 3–7

Stichopus pourtalesi Théel, 1886a, p. 4.
Stichopus natans Théel, 1886a, p. 5.
Bathyplotes bipartius Hérouard, 1912, p. 3, fig. 2; 1923, p. 34, pl. 5, fig. 8; pl. 9, figs. 17–20.

Most specimens hitherto collected are only strips of skin; in case the specimens come up with all their internal organs, they usually get rid of some part of the ventral integument upon which the large fungiform papillae are situated, and the result is that such individuals are naturally referred to another species. This is what happened with the specimens from St. Kitts which Théel examined; the only one which had retained most of its spicules, but lost parts of the ventral integument, was referred to *natans*, although the deposits were quite identical with those of *pourtalesi* from the same lot, and I have myself made the same mistake regarding some specimens from Albatross station 2,632.

The normal outer appearance of the species, which may attain a length of 15–20 cm., is, as Hérouard describes it for his *B. bipartius*, a vaulted dorsal side with huge, conical papillae, placed near the dorsal midline, arranged in two longitudinal zigzag rows and besides smaller papillae, hardly visible; a distinct ventral sole, with small papillae along the edge; mouth ventral, anus subdorsal; near the odd ambulacrum, which itself is devoid of appendages, we find a number of small cylindrical pedicels, which become very numerous toward anus; between these typical appendages and the marginal fringe of papillae there are normally a long band of very large, closely packed "fungiform papillae," most numerous near the anterior part of body and apparently variable in number; they end in a broad yellow disk but seem not to be connected with the vascular system, although some of them seem to contain a cavity. The skin is finely rough to the touch; on the flanks and middle of sole the integument is thick and gelatinous.

The typical fragments contain no trace of internal organs; the description of the anatomy is therefore taken from the only specimen in which these organs are present, collected from the same locality, containing the same kind of spicules, but lacking all trace of fungiform papillae, the sole being somewhat damaged in that part of it where they are situated in the typical specimens.

A very low calcareous ring, one long Polian vesicle, placed near the left ventral interambulacrum; stone canal attached to dorsal integument but without penetrating it; intestine relatively short, mesentery attached to dorsal interambulacrum, almost reaching the cloaca and turning forward across left dorsal and ventral ambulacra, and midventral muscle band, about one third body length from oral end and then proceeding backwards in the right ventral interambulacrum. Respiratory trees free, the right is the longest; stem wide, lateral branches short with few lobes. Musculature, dorsal bands broad and undivided, ventral bands, especially the odd one, are deeply furrowed. Genital organs are attached near oral end; the specimen examined is a female and the organs are filled with ripe eggs; each tuft consists of several slender ducts, each of these ending in a cluster of thick, short tubes, divided once; the clusters are of very variable size.

Deposits.— Quadriradiate bodies with ends branched, or perforated by few but relatively large holes; spire is distinctly tapering in its upper half, where the cross beams are found; small spines are usually present on the sides, but in some specimens they are almost absent (diameter of deposits about 0.1 mm.; height of spire, 0.05 mm.).

In pedicels I have missed end plates and found only a few supporting

rods of simple shape; in lateral papillae there are, on the contrary, numerous spinose rods, and similar deposits but larger are present in the stalk of the tentacles. No C-shaped bodies have been observed in any part of the body.

Type locality.— St. Kitts; depth 370 m.

Type in Museum of Comparative Zoölogy, cat. no. 435.

Also from Ambergris Cay, British Honduras, 1,080 m.; Barbados, 370 m.; Guadeloupe, French West Indies, 1,280 m. Albatross station 2,632 (16° 42′ N., 100° 11′ W., 838 fms.).

Described by Hérouard as *B. bipartius* from off the Canary Islands. One of his specimens in the Museum of Comparative Zoölogy has been compared with the types of Théel's species.

Pelopatides Théel 1886

Diagnosis, after Théel.— Tentacles 15–20, peltate, or subdigitate on margin of the crown; no tentacle ampullae; body more or less depressed, often with a conspicuous overhanging border, bearing a single series of numerous papillae; this border or brim obsolescent in some species except at fore and hind ends of the body; pedicels form a double row on hinder third or two thirds of midventral radius, and in some species also a single row along either ventrolateral radius, in addition to papillae; single series of papillae on dorsal ambulacra; gonads in two tufts, a right and left, mouth ventral; anus dorsal or subdorsal.

Deposits, when present, simple, triradiate or quadriradiate rods, either smooth or spinous; with slightly branched tips; deposits often entirely wanting. A rete mirabile is sometimes present.

Type species.— *P. confundens* Théel.

In spite of the fact that *Pelopatides* is a well-defined genus, the determination of the species is extremely difficult, as the animals are so injured by being hauled up in the dredge.

From the Atlantic Ocean only two species are known at present.

Pelopatides gigantea (Verrill)

Benthodytes gigantea Verrill, 1884, p. 216; 1885, p. 538, pl. 11, figs. 31a-b.
Pelopatides agassizi Théel, 1886a, p. 3.
Pelopatides grisea Perrier, 1901, p. 361.

The type as well as most of the numerous specimens in the United States National Museum are large specimens, the majority being about 20–25 cm. in length. Body flattened, broadly oval, with very

broad lateral brim. Mouth ventral, tentacles very small, retracted into small pockets, the exact number could not be determined; anus dorsal; ventral midline for two-thirds of its length provided with small appendages; dorsal side likewise, with a few small, inconspicuous appendages along the ambulacra. Integument thick, gelatinous; the deposits are very rarely dominating enough to give any roughness to the surface. Color varying from almost pure white with tentacles and the area around them as well as the ventral appendages, blackish violet, to speckled or uniformly violet, especially on the ventral side.

The body cavity of this species is remarkably small and narrow and does not extend into the lateral brim. No calcareous ring; one ventral Polian vesicle; one very small dorsally attached stone canal. Intestine seems to have been relatively short; it is attached in the dorsal interambulacrum, along the underside of the left dorsal muscle band and crosses the left and midventral muscle band about one-third of the body length behind the oral end, and runs finally backwards in the right ventral interambulacrum; the right respiratory tree is long, slender and attached to the lateral interambulacrum; the left is short, bushy, and has apparently been connected with the small rete mirabile which seems to be present (fragments are hanging to the intestine). Muscle bands well developed; the dorsal ones are wide, divided into equally broad parts; the lateroventral is divided into a narrow dorsal portion and a broad ventral part; the midventral is divided into equal halves. Genital organs in the largest specimens attached 5–6 cm. behind the oral opening as two tufts of long, divided threads.

Deposits.— Few, present only as large three-armed bodies with solid outer spire ending in a few teeth which are usually broken off; the arms are straight but slightly inward bent and provided with a few holes in their free end. No deposits are developed in the appendages; in tentacles there are several simple, pointed rods, smooth or with a few nodules.

Several specimens from various localities along the eastern coast of the United States have been examined.

If this species is identical with Perrier's *P. grisea*, then it also occurs near the Canary Islands and Azores ("Talisman").

Remarks.— This species has been united with *P. confundens* Théel, from the eastern tropical Pacific, by Ludwig, 1894. All the specimens of *P. confundens* which have hitherto been collected are much smaller, apparently more elongate, and according to the figures given by Théel squarish in outline. Perrier believes that the Atlantic form he has examined has the spicules with more inwardly bent arms than in typical

P. confundens, but the spicules are too few and variable in these species to allow such a distinction. The Atlantic and the Pacific forms are at present too little known to be united under one name.

Pelopatides atlantica Hérouard

P. atlantica Hérouard, 1902, p. 16, p. 1, fig. 15.

Type locality.— East of the Azores; depth 4,020 m.

No deposits. Description not quite clear; it appears as if the ventral appendages are partly situated on the odd ambulacrum, partly on the lateral ambulacra.

Synallactes Ludwig 1894

Rediagnosis, Perrier, 1901.— Body cylindrical or subcylindrical; (18–)20 tentacles; no tentacle ampullae; stone canal attached to integument; ventral side flattened but not limited by a marginal brim; ambulacral feet on ventral side and dorsally papillae arranged in rows, placed on the radials; on ventral especially distinctly in rows, forming 3 series, single or double. Genital organs in two tufts, anus not in a furrow and lacking anal teeth. Muscle bands divided.

Deposits present in skin and appendages, and often, but not always, as cross-shaped bodies with a simple spine, often bifid.

Type species.— *Synallactes alexandri* Ludwig.

In contrast to the Indo-Pacific Ocean where this genus is richly represented, there is at present only one species known from the Atlantic Ocean.

Synallactes crucifera Perrier

Synallactes crucifera Perrier, 1898, p. 1665; 1899, p. 247; 1901, p. 339, pl. 12, figs. 5, 6; pl. 17, figs. 21–35.

Type locality.— Coast of Morocco; depth 2,212 m.

Amphigymnas Walsh 1891

Rediagnosis — Closely related to *Synallactes*, but in its texture resembling a Deimatid. Skin thin, glass-like, filled with large deposits, derived from tables; spire 3–4 pillared with 1–2 cross beams and no teeth on top, often reduced or entirely absent, so the large plates resemble the plates found in the Deimatids; dorsally large, conical papillae, ventrally a lateral row of large and conical pedicels, and a midven-

tral row of smaller ones, filled with numerous supporting rods and a rudimentary end plate.

Type species.— *A. multipes* Walsh.

This genus was established by Walsh in 1891, but it seems as if he has placed some of the specimens of *A. multipes* in another genus as *Pannychia wood-masoni* Walsh. Koehler and Vaney have rejected *Amphigymnas* and regard *multipes* as a synonym of *Synallactes wood-masoni*.

I have had the opportunity to examine only one specimen, the type of *multipes*, so I cannot decide whether *wood-masoni* is identical with *multipes* or not, but it seems to me that *Amphigymnas* is as good a genus as *Synallactes* and *Bathyplotes;* it has neither the solid rod-like spire of the typical *Synallactes*, nor the long spire with the numerous cross beams of *Bathyplotes*. The deposits remind one so much of those found in certain Deimatidae that at first one would be inclined to place it in that group, and it is only when one notes the presence of respiratory trees as well as of smaller tables with more or less complete spire and the long Synallactid-like supporting rods that one realizes that the genus belongs in the Synallactidae.

From the Atlantic Ocean one species is known at present.

Amphigymnas bahamensis sp. nov.

Plate **9**, fig. 9; Plate **10**, figs. 1–6

Two specimens examined

The type is 17 cm. in length; form slender, not able to contract much; mouth ventral, anus terminal; tentacles 20, very lobate dorsally, long stiff papillae arranged in 4 rows, the anterior overhanging the oral opening as in Synallactes; ventrally a lateral row of conical pedicels, and a midventral double row of smaller conical pedicels; integument thin, stiff, glasslike, the tip of the oral papillae violet.

Internally a simple calcareous ring with squarish radials, deeply incised posteriorly and with notches anteriorly; interradials low, with the typical anterior tooth; one Polian vesicle; one dorsally attached stone canal. Intestine attached as usual, third loop runs on left side of midventral muscle band. Musculature narrow, undivided. Respiratory trees small with lateral lobes, hanging free into body cavity; no rete mirabile.

Deposits.— Very large tables with disks perforated by numerous holes; spire often broken and in many cases it appears as if it is quite normally reduced; spire, when present, is slender, composed of 3 rods

and united by some cross beams; it seems never to end in distinct teeth. In ventral feet, numerous long supporting rods with dentate edge, and small tables with 3–4 short rods in spire, ending in more or less distinct teeth; no end plate. In dorsal papillae, very slender dentate rods and tables of medium size, some of them resemble the three-armed rods in *Synallactes*.

Type locality.— "Albatross" station 2,666, between Bahamas and Cape Fear; depth 480 m.

Type in United States National Museum.

Also recorded from "Fish Hawk" station 7,281. Off Florida in 304 fms.

Zygothuria Perrier 1898

Diagnosis, translated from Perrier, 1901, p. 323.— Thirteen to twenty tentacles; stone canal placed close to body wall, without penetrating it; body ovoid, integument often wrinkled; not flattened but with a well-differentiated sole; a single series (rarely two series) of feet in each lateroventral ambulacrum, placed on the margin of the sole; these appendages are widely spread; dorsally, very small papillae, not numerous, irregularly distributed and sometimes totally absent. Calcareous deposits of integument exclusively in the form of tables, either tri- or quadriradiate.

Type species.— *Z. lactea* (Théel).

This genus has been rejected by Sluiter and Hérouard, but it seems to me quite convenient to have a separate genus for this almost footless form, and the shape of the tables seems to be characteristic. Perrier mentions supporting rods in the feet of *Zygothuria;* they are few and often difficult to find, when the appendages are completely contracted, but I think their presence will prove to be a general character in the genus.

No key has been given to the species which at present are said to occur in the Atlantic Ocean, as only one species is satisfactorily known. The two other species, from the eastern part, are very little known and may probably be identical. The Zygothuria sp. from the West Indian region is probably identical either with one or both of the eastern forms, or it is a new species, which is at present unsatisfactorily known.

Zygothuria lactea (Théel)

Plate 8, figs. 8, 9

Holothuria lactea Théel, 1886, p. 183; 1886a, p. 6.
Zygothuria lactea Perrier, 1901, p. 322, pl. 17, figs. 1–6.

Zygothuria lactea var. *oxysclera* Perrier, 1901, p. 323, pl. 17, figs. 7–10.
Mesothuria laetea Sluiter, 1910, p. 332. Hérouard, 1902, p. 21, pl. 1, figs. 17–19; 1923, p. 13, pl. 4, figs. 1–3.

About 20 specimens examined

The size most frequently met with is 6–15 cm., but larger specimens may occur; smaller specimens seem never to occur in collections. The outer shape is usually difficult to make out, except when the specimen has been treated very carefully; the usual impression one has is of a dirty whitish sack, much wrinkled and sandy to the touch, without any appendages whatever. A very fine figure is given by Hérouard in 1902. Oral opening ventral, the small tentacles with lobate margin are usually completely retracted; their number seems to be somewhat variable, varying from 15–20, but it may be that some of them have been overlooked; anus terminal; appendages are present only on a row along the outer side of the lateroventral muscle bands; color is as mentioned above, white, often dirty; the mud-filled intestine is often visible through the body wall.

Internal anatomy is often difficult to study, as it is usually badly preserved; in most cases the entire body cavity is filled with mud from the intestine which has been partly destroyed, and in this mud all organs are concealed. Calcareous ring is low, loosely built, much undulated; one small ventral Polian vesicle is present, and a dorsal stone canal which reaches the dorsal side; intestine comparatively short, of normal course; respiratory trees free with wide stem, with relatively few lateral lobes; muscle band narrow, often with a longitudinal furrow but not divided; genital organs placed near the oral end on left side of mesentery, of the typical shape: several tufts of short, divided tubes on the end of a long duct; anterior tubes being small and unripe, the posterior ones on their way to become absorbed and all containing the same kind of genital products.

Deposits.— Very fragile tables of the triradiate type, with 6 large holes around a small triangular central hole; spire high, usually with 3 long smooth arms on top. There is considerable variation as regards the diameter of the tables and the height of the spire; the disk is smallest, and most irregularly formed, with small accessory holes in the integument near appendages, and increasing in size in the dorsal integument. Hérouard gives the variation as being from 0.142–0.220 mm. in diameter, and I have found about the same sizes. Moreover, there are often several tables which have only one centrally placed strong spine or arm instead of 3, as Théel noted as early as 1886; it may be that this type of table, with a disk of the same diameter as the other

normal tables, becomes more numerous in older specimens. Perrier's var. *oxysclera* is based upon such very large specimens, in which all deposits were single pointed.

No end plate is present in the feet but a few supporting rods are present in the cylindrical part of the appendage; they are often difficult to detect, when the appendages are retracted; in tentacles we find quite a number of almost smooth, pointed, simple rods, strongly or slightly curved.

Type locality.— Off New Zealand ("Challenger").

Type in the British Museum.

Distribution in the Atlantic Ocean.— Recorded for the first time from the coast of the United States by Théel, who noted the characteristic difference between the type and the Atlantic specimen in the presence of the single-pointed tables.

Later, Perrier recorded several specimens from the coast of Morocco and off the Canaries, depth about 2,000 m., and he has furthermore described a new variety (*oxysclera*), based upon very large specimens, with single-pointed tables exclusively; apparently he overlooked Théel's record of the presence of such tables in specimens from the western part of the Atlantic Ocean.

Still later Hérouard found the species in the Bay of Biscay, and noted that the majority were the variety *oxysclera*, but the specimens contain also normal tables and he agreed with Sluiter (1901) that *oxysclera* cannot be maintained.

Examination of the specimens in the Museum of Comparative Zoölogy and United States National Museum shows that this species is extremely common along the coast of New England, and it occurs also in the West Indian region near the Antilles and in the Gulf of Mexico.

Depth.— As usual we find that the species occurs at a lesser depth in the western part of the Atlantic Ocean, about 800–1,200 m. being the common depth, whereas most of the eastern records are from a much greater depth, from 2,000 m. or more.

Remarks.— I have not been able to find any distinguishing characters between the type form and Atlantic specimens, so at present we must take it for granted that *Z. lactea* occurs in both oceans; the occurrence of single-pointed tables seems not in itself to be a very important distinguishing character, and the Pacific form probably has this type of table also, as will appear when more material is available.

Regarding the wide range of variation which the present species is said to exhibit, I cannot agree with most authors. It seems to me that the species does not vary much; its outer appearance is very constant

and the variation of spicules is within reasonable limits as far as my experience goes. We find some range of variation of the spicules in one individual and the single pointed type of tables seems to become more numerous in older specimens, but aside from these facts the species is very constant in its characters.

Zygothuria connectens Perrier

Zygothuria connectens Perrier, 1901, p. 327, pl. 17, figs. 11–14.

Three small specimens from off Sahara and the Canaries ("Talisman"), in bad condition, described in all details by Perrier.

The spicules seem typically to be larger than those of *Z. lactea*, although the largest among them are undoubtedly juvenile tables which cannot be regarded as typical; the disk is very irregular; the spire is high and ends usually in four long smooth arms, curving upwards.

Type locality.— Off the coast of Sahara and near the Canaries. Depth 1,975–2,518 m.

Type in Paris.

Zygothuria candelabri Hérouard

Mesothuria candelabri Hérouard, 1923, p. 17, pls. 1–10.

Of this form only fragments are known, and it is therefore doubtful whether it belongs to *Zygothuria* or *Mesothuria;* Hérouard, who rejects the genus *Zygothuria*, does not mention the presence or absence of appendages, but says that judging by the spicules, it seems to stand near to *Z. connectens* Perrier. I have chosen to place it in the genus *Zygothuria*, as I regard Hérouard's silence about the appendages as a sign that they are absent.

The tables are intermediate between tri- and quadriradiate type, often with 7 large irregular holes; the spire is high with very long arms, which are curved upward (not straight as in *lactea*) and provided with some small spines. If these spines were absent, I would not hesitate to regard the species as a synonym of *Z. connectens*.

Type locality.— Bay of Biscay ("Princess Alice"); depth 4,870 m.

Type in Monaco.

Zygothuria sp.

Plate 8, fig. 7

Only a single specimen is at hand, 10 cm. in length, of the typical shape with small tentacles, completely retracted and ventrally di-

rected; anus terminal; ventral side with a series of very small lateral papillae mostly recognized from inner side of body wall by their ampullae; dorsally some very small appendages which apparently are arranged along the ambulacra. Skin much thicker than in the typical specimens of *lactea*, with very distinct lateral thickening; color white; integument not transparent but opaque; more rough to the touch than that of *Z. lactea*.

Internal anatomy quite typical; a low, loosely united calcareous ring, a small ventral Polian vesicle; a dorsally attached stone canal which reaches the dorsal integument; short muscle stomach, and not very long, mud-filled intestine of normal course. Only one of the respiratory trees is left; it has a wide stem and several large lobes; muscle band narrow, the midventral furrowed; genital organs of the typical shape: numerous ducts ending in fertile tubes which in this form are very short, usually divided once.

As in *Mesothuria* we find that the posterior part of the genital basis has remnants of partly resorbed tubes, whereas the anterior part has smaller, unripe tubes; the specimen examined, a female, contained ripe eggs in the large tubes and unripe eggs in the small tubes

Deposits.— Tables, larger than in *lactea* and more irregular in the shape of the holes, very often the margin is incomplete; well-developed typical spire with three rods, ending in three long smooth teeth or arms. No rods in appendages or in tentacles.

This form is undoubtedly different from *lactea*, which is so richly represented in the waters along the coast of New England; it may be that it is identical with Perrier's *connectens;* the tables seem to be of the same size, but the disk is more complicated in Perrier's specimen, and a number of them have four rods in the spire, which I have never found in any preparation made from the specimen which I have examined. Perrier's example is, however, very small, so that it may be an immature character that the disk of the tables is different; I have therefore left the question unsettled until more material is available.

Specimen examined.— Museum of Comparative Zoölogy, cat. no. 429.

Locality.— Off St. Vincent, British West Indies, 573 fms.

Paroriza Hérouard 1902

Diagnosis, after Hérouard, 1902, p. 26.— Twenty tentacles; no free tentacle ampullae hanging into the body cavity; ventral side somewhat flattened, and without any feet on the ventrum; dorsally scattered,

straight or curved conical appendages, not numerous; mouth and anus ventral; two genital tufts; two respiratory trees. No deposits.

Type species.— *P. prouhoi* Hérouard.

Two species are at present known from the Atlantic Ocean, namely *P. prouhoi* Hérouard, 1902, p. 24, pl. 7, figs. 1, 2; pl. 8, fig. 30; 1923, p. 29, pl. 2, figs. 3, 4. Perrier, 1901, p. 323 and *P. pallens* (Koehler), 1896, p. 50–52, described as *Stichopus*.

Neither of these species have yet been recorded from the West Indian region or New England waters.

ELASIPODA Théel 1882

Diagnosis, from Ekman, 1925, p. 536.—Appendages present; tentacles built after the peltate type; oral retractors and respiratory trees absent. Mesentery of the third loop attached to right interradius and usually close to the dorsal muscle band. Among the deposits we find pointed rods or derivates from these. The outer shape of the body is distinctly bilateral.

The Elasipoda are divided into 4 families; in the present key the very aberrant genera *Pelagothuria*, *Enypniastes* and *Euriplastes*, which lack deposits, are included.

Key to the families and subfamilies

1. Deposits present 2
1. Deposits absent. V. Fam. (Cyclionidae) 7
2. Ventral radius with well-developed appendages; 15–20 tentacles 3
2. Ventral radius practically without appendages 4
3. No wheels among the deposits, which are either simple rods or four-armed deposits, often with outer projection ...... III. Fam. *Psycropotidae* Théel
3. Wheels numerous among deposits . II. Fam. *Laetmogonidae* Ekman (partim)
4. Deposits wheels .... II. Fam. *Laetmogonidae* Ekman (partim)
4. Deposits no wheels (a few rudimentary ones may be present in some forms) 5
5. Deposits plates or large dichotomously divided rods or short stout rods. No wheels at all. Appendages uniformly distributed in rows along the paired ambulacra; 20 tentacles .... I. Fam. *Deimatidae* Ekman
5. Deposits pointed rods, often with long vertically directed secondary spines, placed near the ends of the main rod, or derived from primary crosses, with four inner arms and 1–4 outer basal projections. Appendages usually unequally distributed in the respective ambulacra. 10 tentacles. (IV. Fam. *Elpidiidae* Théel) 6

6. The predominating spicules are rods with vertically placed spines placed near the end of the main rod; also C-shaped bodies and in some cases a few rudimentary wheels; cloacal caecum usually present.
VI. Subfam. *Elpidiinae* Ekman
6. The predominating deposits are derived from primary crosses with four inner arms and 1–4 outer projections. No cloacal caecum.
VII. Subfam. *Peniagoninae* Ekman
7. Lateral radii with a series of 8 feet on the posterior part and a double row of ordinary appendages on the anterior part, behind the nuchal crown; 12–20 tentacles.......................... Group *Reptantia* Hérouard
7. Lateral radii devoid of appendages behind the collar; only with a few vestiges of papillae; 20 tentacles............... Group *Natantia* Hérouard

DEIMATIDAE Théel (partim)

Diagnosis, from Ekman, 1925, p. 536.— Calcareous bodies large, mostly primary crosses, reticulated plates and dichotomously branched rods. Wheels absent. Marginal papillae strong; calcareous deposits placed parallel to the longitudinal axis of the papillae; the genital tubes are simple; the second loop of the intestine without a continuous mesentery; in the remaining loop the mesentery forms a complete membrane. Feet well developed in the lateroventral ambulacra; usually absent in the odd ambulacrum.

Four genera are usually recognized; a fifth, *Amphideima* Koehler and Vaney (1905) from the Indian Ocean is somewhat doubtful, and is therefore not included in the following key.

Key to the valid genera

1. Deposits, fenestrated plates; anus ventral............................2
1. Deposits, not fenestrated plates; anus placed in various ways...........3
2. Short forms; tentacles small, retractile, lateral feet in simple rows; dorsal papillae also in simple rows................................*Deima*
2. Elongate forms, tentacles large, non-retractile; lateral feet in a zigzag row; dorsal papillae in simple or double rows..................*Oneirophanta*
3. Deposits as long-armed, cross-shaped rods; lateral series of feet in zigzag to double rows; dorsal papillae in double rows. Anus ventral. (*Scotodeima*)[1]
3. Deposits short, robust, spinous rods; besides more slender, dichotomously branched rods. Lateral series of feet in a single row; dorsal papillae in double rows. Anus subdorsal.........................*Orphnurgus*

[1] *Scotodeima* is by some authors (Ohshima, Ekman) united with *Orphnurgus*.

Deima Théel 1882

Diagnosis.— Tentacles 18–20, small and capable of being retracted within the mouth. The lateral ambulacra of the ventral surface, with large pedicels disposed in a single row along each side of that surface, and another series of very elongated, conical, rigid, nonretractile processes, placed externally and above the pedicels, all along each side of the body and directed straight outwards. The odd ambulacrum naked and provided with a few abortive pedicels. The dorsal side with processes resembling those of the ventral lateral ambulacra, disposed in a single row along each ambulacrum. Integument with crowded irregularly rounded perforated plates, forming a rather hard "skeleton."

Type species.— *Deima validum* Théel.

Key to the species at present known from the Atlantic Ocean

1. Deposits composed of a single layer; 11 lateral feet; 6 lateral papillae and 6 dorsal papillae (in very large specimens 7) on each side. *Deima blakei* Théel
1. Deposits composed of two layers; 11 lateral feet; 5 lateral papillae, and 3 dorsal, on each side .... *Deima atlanticum* Hérouard

Deima blakei Théel

Plate **10**, figs. 7–11; Plate **11**, figs. 1–3

Deima blakei Théel, 1886a, p. 1, figs. 1, 2. Hérouard, p. 40, pl. 5, fig. F; pl. 6, fig. 5. Koehler and Vaney, 1905, p. 55, pl. 11, figs. 13–15.

The average size for this species is about 10 cm.; a single specimen is 13 cm. long. The body is relatively short with flattened ventral side and vaulted dorsal side. The tentacles are completely retracted. The typical number for the appendages seem to be, on each half part of the body: 11 pedicels, 6 lateral and 6 dorsal papillae (the exceptionally large specimen has 7 dorsal papillae). On the midventral radius we find 2–3 abortive pedicels.

The present material seems to indicate that there is a difference in the outer characters corresponding to sex. Females have much stouter papillae than the males, but it may be merely accidental.

Internal anatomy seems to be very typical. A low calcareous ring, composed of 10 pieces; a small ventrally placed Polian vesicle, a short stone canal which opens dorsally. The intestine is very short, and is attached in the dorsal interambulacrum and in the right lateral interambulacrum; there is no mesentery to the second loop. The genital

organs are attached near the oral end in two tufts, and are simple tubes. In the material examined they were ripe and showed some difference in the male and the female; in the male they were cylindrical and white; in the female they were thickest at the middle and yellow; in both cases the wall of the tubes is glasslike, filled with spicules.

The deposits are very large plates with large central holes and several small marginal ones; all stages may be found from rods with dichotomously divided ends or with only a few large holes, to the complete plates. The deposits are never built up of more than one layer; the outer surface often carries some scattered spines.

In the feet we find delicate spectacle-shaped rods or simple, smooth to slightly spinous rods and elongate plates of the same type as in the integument. Apparently no end plate; in the tentacles similar rods.

Type locality.— Off St. Vincent; depth 573 fathoms.

Type in the Museum of Comparative Zoölogy.

Also from south of Jamaica, 610 fathoms depth and from near the Azores (2,779 m.).

According to Koehler and Vaney this species is also found in the Indian Ocean. This determination is doubted by Hérouard, but the figures which Koehler and Vaney give agree perfectly well with the deposits of *D. blakei.*[1]

Deima atlanticum Hérouard

D. atlanticum Hérouard, 1898, p. 88; 1902, p. 32, pl. 3, figs. 5–8.

Characterized by 11 lateral feet, 5 lateral and 3 dorsal papillae in each body half. Deposits composed of more than one layer.

Type locality.— Between Azores and Portugal. Depth 3,460 m.

Type in Monaco.

Not yet recorded from the western part of the Atlantic Ocean.

Orphnurgus Théel

Diagnosis.— Tentacles 15–20, rather large, nonretractile. Lateral ambulacra of ventral surface with very large pedicels, disposed in a single row all along each side of that surface, and with another series of slender flexible processes placed above the pedicels, all along each side of body. Odd ambulacrum naked. Dorsal surface with a more or less crowded series of numerous long papillae, disposed in one or two rows

[1] The deposits are composed of a single layer covered by a few secondary wide-meshed rods (perhaps an artefact). Both *validum* and *fastosum* have reticulated network in their deposits.

along each dorsal ambulacrum. Integument with deposits in the form of smooth or spiny rods, sometimes dichotomously branched, or rods transformed into solid, large ellipsoids.

Type.— *O. asper* Théel.

ORPHNURGUS ASPER Théel

Plate **11**, figs. 4–8

O. asper Théel, 1882, p. 82, pl. 15; pl. 34, figs. 15, 16; pl. 38, fig. 10; pl. 41, fig. 3; pl. 44, fig. 3; 1886a, p. 2.

The single specimen at hand is poorly preserved but seems to agree in all respects with the type, and it is unnecessary to repeat Théel's description.

Type locality.— Sombrero Island, Lesser Antilles, from 810 m. depth. Type in British Museum.

Also off Guadeloupe, from 1,049 m. depth. According to Koehler and Vaney, *O. glaber* Walsh from Gulf of Bengal is merely a variety of *asper.*

ONEIROPHANTA Théel 1882

Diagnosis.— Tentacles 20, large and not capable of being retracted within the mouth. The lateral ambulacra of the ventral surface with large pedicels disposed in a double row along each side of that surface, and with another series of very elongated, conical, more or less flexible, non-retractile processes, placed externally and above the pedicels all along each side of the body. The odd ambulacrum with a few more or less rudimentary pedicels. The dorsal surface with processes, resembling those of the ventral lateral ambulacra, disposed in a single row along each of its ambulacra. Integument with more or less crowded, irregularly rounded, perforated plates, sometimes forming a rather hard skeleton.

Type.— *O. mutabilis* Théel.

Key to the species of Oneirophanta known from the Atlantic Ocean

1. Dorsal appendages of almost equal size. Elongate rods present in dorsal integument . . . . *O. mutabitis* Théel
1. Dorsal appendages in pairs of alternate size. No elongate rods in dorsal integument . . . . *O. alternata* Perrier

Two species and a variety are recorded from the Atlantic Ocean, none of them has as yet been reported from the West Indian region.

Oneirophanta mutabilis Théel

O. mutabilis Théel, 1886, p. 62, pl. 21, fig. 2; pl. 22, figs. 1–3; pl. 36, figs. 1–2, 8–11; pl. 37, figs. 4, 13; pl. 38, figs. 11, 12; pl. 40, figs. 1–3; pl. 41, figs. 1, 2, 4; pl. 42, fig. 9; pl. 43, figs. 1, 6; pl. 45; pl. 46, figs. 6, 7. Perrier, 1901, p. 374, pl. 18, figs. 10–15. Hérouard, 1923, p. 39, pl. 4, figs. 1–10; pl. 5, figs. 2–3.

Type locality.— Pacific Ocean.

Type in British Museum.

Recorded from Gulf of Panama ("Albatross"), several localities in the Pacific Ocean, south of Australia, southeast of Africa ("Challenger"), also from Gulf of Bengal ("Investigator"). In the Atlantic Ocean reported by "Challenger" from off Montevideo, later taken in numbers from between Azores and Portugal ("Talisman").

Bathymetrical range, usually between 2,000–5,000 m. (from the Andamans reported from only 500 m. depth.

Oneirophanta alternata Perrier

O. alternata Perrier, 1901, p. 380, pl. 14, figs. 3–4; pl. 18, figs. 16–21.

Occurs in the same localities in the eastern Atlantic Ocean as *O. mutabilis*. Perrier also has recognized a variety *O. alternata* var. *talismani*. It is characterized by having the dorsal appendages arranged in pairs on each dorsal ambulacrum, a pair of large papillae alternating with a pair of small papillae. Perrier has, moreover, noted some differences in regard to the distribution of the spicules. No elongate rods are present in the dorsal integument.

It is possible that *O. alternata* and its variety are only varieties of the apparently very variable species *O. mutabilis*. It is also possible that we have a difference between the two sexes, as in *Deima blakei*, where we find some difference in the texture of the integument and the size of the papillae in female and male.

Scotodeima Ludwig 1894

Not represented in the Atlantic Ocean. The genus stands between *Oneirophanta* and *Orphnurgus* and is by some authors (Ohshima, Ekman) included in the latter genus.

LAETMOGONIDAE Ekman 1926

Diagnosis.— Deposits only as wheels and other small deposits. The papillae are usually flexible, without special armature. Genital organs

unbranched. Mesentery as a continuous membrane, present also in the second loop. Dorsal papillae uniformly developed in all parts of the ambulacra. Feet in the lateroventral ambulacra large, well developed; in the odd ambulacrum absent in most cases, or much smaller.

Most of the genera are Indo-Pacific forms. Only two genera, namely *Laetmogone* and *Benthogone*, are with certainty known from the eastern Atlantic. (Hérouard's *Pannychia glutinosa* is undoubtedly a young specimen of *Benthodytes lingua* Perrier. A poorly preserved specimen is designated as *Laetmophasma* sp.? by the same author, but I doubt very much the correctness of his statement.)

Key to the genera known from the Atlantic Ocean

1. Numerous small hair-like papillae scattered over the entire surface. Lateral feet large, cylindrical. Tentacles very much like the lateral feet in form and size . . . . *Laetmophasma*
1. No hairlike papillae scattered over the surface 2
2. Pedicels retractile, dorsal appendages minute. Wheels extremely vaulted, cuplike . . . . *Benthogone*
2. Pedicels nonretractile; dorsal appendages good sized. Wheels flat. *Laetmogone*

Laetmophasma Ludwig 1894

Diagnosis.— Sixteen to twenty tentacles, rather large, nonretractile; in each ventrolateral ambulacrum a single row of large feet; dorsal and ventral sides covered with numerous papillae. Wheels, similar to those found in *Pannychia*.

Type species.— *L. fecundum* Ludwig.

Hérouard describes, 1902, p. 35, a poorly preserved specimen from near the Azores which could possibly be referred to this genus. Aside from this specimen, the genus is known only by the type species from the eastern tropical Pacific.

Laetmogone Théel 1882

Diagnosis, from Théel, 1882, p. 73.— Tentacles fifteen, rather large, not retractile. The lateral ambulacra of the ventral surface with very large pedicels, disposed in a single row along each side of that surface. The odd ambulacrum naked. The dorsal surface with extremely elongated, flexible, cylindrical, nonretractile processes, disposed in a single row along each side of its ambulacra. Integument, with numerous wheels and, besides these deposits, spicules or cruciform bodies.

Type species.— *L. wyville-thomsoni* Théel.

The genus is represented in the eastern part of the Atlantic Ocean by two species, both of which are said to occur also in the Indo-Pacific. Both species may be expected along the coast of North America and in the West Indian waters.

Key to the two species

1. Slender form, several times longer than broad. Dorsal appendages few, long, slender and widely spaced; their number is much less than that of the ventral feet........................*Laetmogone wyville-thomsoni* Théel
1. Short form, at most two and a half times as long as broad. Dorsal appendages short, slender and closely placed; their number is larger than that of the ventral feet........................*Laetmogone violacea* Théel

It seems as if there were something uncertain about these two species. They have undoubtedly in many cases been confounded. It is usually stated that *L. wyville-thomsoni* lacks an outer layer of cross-shaped, hollow, spinous deposits, which characterizes *L. violacea.* It is undoubtedly a fact that this outer layer is often rubbed off, and specimens lacking these deposits have been referred to *L. wyville-thomsoni,* while those which possess them are referred to *L. violacea;* the miserable condition in which these animals are usually found makes it quite excusable to pay little attention to the dorsal appendages, which often stick to the gelatinous integument. A specimen from station 1450 ("Princess Alice") is labeled *L. violacea* and contains several cross-shaped deposits, but when the dorsal appendages are prepared they prove to be very long and slender and widely spaced; their number being 9 in each dorsal row, whereas the ventral feet are present to the number of 14 on each ambulacrum. The outer shape thus indicates that the animal is a specimen of *L. wyville-thomsoni.*

This fact explains, therefore, why Koehler regards *L. wyville-thomsoni* as the most common, eastern Atlantic species, whereas Perrier and Hérouard regard *L. violacea* as the most typical Atlantic form.

Laetmogone violacea Théel

L. violacea Théel, 1882, p. 78, pl. 13, figs. 1–3; pl. 36, figs. 20–24; pl. 42, fig. 2. Perrier, 1901, p. 390, pl. 19, figs. 1–7. Mortensen, 1912, p. 290. Grieg, 1921, p. 9. Hérouard, 1923, p. 37. Ohshima, 1915, p. 237 (complete list of literature).

Cryodora spongiosa Théel, 1879, p. 9.

Laetmogone spongiosa Théel, 1882, p. 78.

L. jourdaini Petit, 1885, p. 9.

L. brongniarti E. Perrier, 1886. p. 241.

Type locality.— South Pacific Ocean.

Distribution in the Atlantic Ocean.— West of Greenland, north of Scotland, Bay of Biscay, Gibraltar, off Morocco, Azores and Senegal.

Depth.— 893–1,490 m.

Should the Atlantic and Pacific specimens prove to be different, the name *L. spongiosa* is available for the Atlantic species.

Laetmogone wyville-thomsoni Théel

L. wyville-thomsoni Théel, 1882, p. 73. Koehler, 1895, p. 36; 1896, p. 117. Hérouard, 1902, p. 31, pl. 4, figs. 10–16.

Type locality.— South Indian Ocean.

Distribution.— Not well known at present.

Benthogone Koehler 1896

Diagnosis, modified from Perrier, 1901, p. 398.— Mouth ventral, surrounded by a circle of 15–20 tentacles, which are very little retractile; anus terminal, subdorsal; body flattened or almost cylindrical; ventrally on each side a series of marginal appendages which are rather large and contractile. Dorsally on each side of the median line and a short distance from it, a series of much smaller appendages, delicate and retractile; other papillae may be found, which are much scattered, but also arranged in a longitudinal, outer series. Deposits as wheels, resembling those of *Laetmogone* but more vaulted. The ambulacral appendages contain rods and a rudimentary end plate, as well as the wheels.

Type species.— *B. rosea* Koehler.

Benthogone rosea Koehler

B. rosea Koehler, 1896, p. 116, 1895, p. 53, text-fig. 16. Perrier, 1901, p. 339, pl. 14, figs. 1–2; pl. 19, figs. 8–14.

Perrier establishes the varieties *cylindrica* and *quatrolineata;* both seem to be merely stages of preservation or age.

Type locality.— Bay of Biscay, depth 1,300 m.

Also from off Morocco and Senegal ("Talisman"); south of Iceland ("Ingolf");[1] west of Ireland ("Helga"). Not yet taken in the western part of the Atlantic Ocean, but will probably be found there.

PSYCHROPODIDAE Théel

Diagnosis, Ekman, 1925, p. 537.— Deposits exclusively derived from pointed primary rods which is some species form crosses or four-armed bodies with inwardly curved arms and often an outer central projection. Deposits never derived from primary crosses. Mesentery forming a continuous membrane, well developed also in the second loop. Feet are, as a rule, also present in the odd ambulacrum. Anteriorly the marginal brim contains several appendages which arise from the dorsal radial vascular canals.

Key to the genera

1. Odd ambulacrum devoid of appendages. Deposits cross-shaped rods with slightly inward bent arms and short conical outer projection. IV. *Psycheostrephes*
1. Odd ambulacrum with a double row of pedicels 2
2. Dorsal side posteriorly devoid of an unpaired appendage; only paired papillae, smaller or larger, are developed. Deposits, cross-shaped rods with more or less strongly bent, spinous arms with or without outer projection, or simple, spinous rods, which in some species are extremely scarce. I. *Benthodytes*
2. Dorsal side posteriorly, with a more or less broad, unpaired appendage. Deposits cross-shaped rods with more or less strongly bent, spinous arms and in most cases with outer projection 3
3. Unpaired appendage relatively short, situated anteriorly to the posterior third of the body. Lateral appendages small, relatively numerous and united by a web to form a swimming brim . . . . . . II. *Euphronides*
3. Unpaired appendage very long, tail-like, placed near the posterior end of the body; lateral appendages relatively few, mostly large, conical, and not united by a web . . . . III. *Psychropotes*

The first genus is not known from the Atlantic Ocean; the others are all represented in the eastern part, and several of the species are also known from the western part.

BENTHODYTES Théel

Diagnosis.— Body flattened or elevated, slender or short; mouth ventral, usually situated at some distance from the anterior margin; 12–20 tentacles; anus dorsal, sometimes almost terminal. Ventral ap-

[1] Not published.

pendages numerous in a double row of pedicels in the midventral radius; laterally they form a single series united by a web to a narrow or broad brim; dorsally papillae, either small and insignificant, easily overlooked, or large and prominent; their number seems to be somewhat variable within the species; they are either radial or placed in the lateral interambulacra.

Deposits, either simple pointed, spinous rods, which occur in very limited number, or large cross-shaped bodies with curved spinous arms and usually with a strong, spinous, simple or bifid outer projection.

Key to the species of Benthodytes, at present known from the Atlantic Ocean

1. 20 tentacles. Lateral brim of appendages broad; dorsal appendages very small. Deposits simple, spinous rods often few in number. . *B. typica* Théel
1. 14–15 tentacles; lateral brim of appendage forming a narrow limit round the ventral sole; dorsal appendages either thread-like or conical. Deposits cross-shaped, with or without outer projection 2
2. Deposits robust; outer projection stout, with numerous spines often divided into two or three stems. Elongate form, with slender dorsal appendages. *B. lingua* Perrier
2. Deposits not very robust; arms slender; outer projection slender or absent.
3. Dorsal appendages of unequal size; four pairs much longer than the remaining ones . . . . *B. janthina* v. Marenzeller

Benthodytes typica Théel

B. typica Théel, 1882, p. 103; 1886a, p. 2. v. Marenzeller, 1893, p. 12 Perrier, 1901, p. 456, 466. Grieg, 1921, p. 10, pl. 3, figs. 6, 7. Hérouard, 1923, p. 102, pl. 6, fig. 4, 1896, p. 903.

B. glutinosa Perrier, 1901, p. 462, pl. 13, fig. 5; pl. 20, fig. 31. Grieg, 1921, p. 10, pl. 3, figs. 1, 2.

About 30 specimens examined

The maximum length of this species, so common in the West Indian region, seems to be 10–15 cm. Most examples are very poor, and present only a bundle of five fleshy muscle bands surrounded by some tissue which is colored dark reddish violet. When the animal is complete, it presents a short body with a very broad brim; ventrally directed mouth, surrounded by 20 tentacles; anus terminal. The midventral radius with a double row of pedicels, the dorsal side with a few scattered papillae. The lateral appendages are very easy to trace, as

their vascular portion is deep violet and the remnants of them are always visible as peculiar violet transverse bands. The dorsal appendages are usually overlooked, and examination of a very great number of specimens shows that the pedicels in the midventral radius are very often hard to trace; the specimens in which the ventral appendages seem to be scarce have often been referred to *B. glutinosa.*

The color is intensely reddish violet; the appendages are especially deeply colored as well as the lining of the body cavity, whereas the connective tissue of the integument is milky white, opaque.

Internally we find a long and narrow body cavity, the walls of which are practically covered by the very fleshy muscle bands. Calcareous ring in the usual low state of development; a long ventrally placed Polian vesicle and a short dorsal stone canal, which opens to the outer surface. The intestine is short, and by means of a fenestrated mesentery attached in the dorsal interambulacrum, in the left lateral interambulacrum and along the lower side of the right dorsal muscle band. Muscle bands fleshy, tapering toward the oral end, yellowish in color. Apparently only males have been examined; their genital organs consist of two slender ducts with numerous bundles of small slender fertile tubes. Females undoubtedly have genital organs of the usual type with a short duct, with thick globular fertile tubes.

Deposits.— A few scattered spinous rods, most numerous in the tentacles.

Type locality.— Off Gibraltar.

Type in British Museum.

Distribution.— From off the Azores; off Martinique; off Bequoia, Gulf of Mexico, west of Haiti and from Cape Hatteras to Nantucket.

Depth.— From 1,400–3,514 m. The lowest depths are as usual found in the western part of the Atlantic Ocean.

Remarks.— It is impossible to decide whether this species is identical with *B. glutinosa*, recorded by Koehler and Vaney from the Indian Ocean and by Clark from the eastern tropical Pacific.

Benthodytes lingua Perrier

B. lingua Perrier, 1896, p. 902; 1901, p. 466, pl. 12, figs. 1, 2; pl. 21, figs. 1–9.
B. sp. Théel, 1886a, p. 3.
Pannychia glutinosa Hérouard, 1902, p. 32, pl. 4, fig. 17.

About 10 specimens examined

The species seems to attain a length of about 25–30 cm. The specimens from the West Indian region agree perfectly with Perrier's de-

scription. Fifteen large tentacles, ventrally directed, surrounded by a circle of very small appendages; a distinct flattened sole with a double row of feet in the midventral radius and a narrow brim of small appendages united by a web, forming the border. Dorsally a few, whip-like papillae are present, but they are often inconspicuous. The color is either dark violet or more reddish, as noted also by Perrier. The integument is extremely rough, because of the enormous spicules which it contains; they seem usually to be best developed near the oral end, dorsally.

Internal anatomy quite normal, with a fragile semitransparent calcareous ring, a ventrally placed Polian vesicle, and a dorsal stone canal connected with the outer surface; the course of the intestine could not be made out in the present material. The longitudinal muscle bands are thin. The genital organs which are ripe present the typical difference between the female and the male; the organs in the former are short, resembling a corn cob, with few and short thick tubes, closely packed together; the latter are long with several slender tubes arranged in tufts along the main stem.

Deposits.— Very large deposits, several millimeters long, their entire shape visible to the unaided eye. They are developed as large crosses with stout inward bent arms, covered with strong spines, and with an outer central projection which likewise is covered with spines, and in most cases is divided into 2 or 3 equally large stems, a quite unique feature, by which these spicules are easily recognized. In the tentacles simple spinous rods.

Type locality.— Coast of Morocco.

Type in Paris.

Distribution.— From the type locality; several localities in the West Indies, off the Antilles and in the Gulf of Mexico and also along the coast of New England.

Depth.— 860–2,200 m.

Benthodytes kerhervei (Hérouard)

Psychropotes kerhervei Hérouard, 1902, p. 27, pl. 4, figs. 1–9; 1923, p. 104, pl. 3, figs. 4, 5.

With some doubt I refer a specimen from St. Croix to this species, which has hitherto been known only from off the Azores. The specimen is 5–6 cm. long, very short, with decidedly vaulted dorsal side with a few small appendages found near the middle of the back; the ventral side forms a distinct sole, limited by small papillae united to a narrow

brim and with a midventral row of pedicels; the tentacles are 15 in number and also ventrally directed; the anus is terminal. The color is dark violet; the integument is smooth to the touch.

The internal anatomy was not suitable for examination; the only organs well preserved are the genital organs, which contain large eggs and are of the typical form, short and compact with short, thick, fertile tubes. The deposits are few and of the same form as those figured by Hérouard, relatively small crosses with few, irregularly distributed spines, and a very small spinous outer projection or none at all.

Type locality.— Between Azores and Portugal.

Depth.— 3,825–5,005 m.

Type in Monaco.

Distribution.— From the type locality and off St. Croix, West Indies, in 2,376 fms.

Remarks.— The reason why I have placed this species in *Benthodytes* is because Hérouard's figures are not very convincing; the dorsal appendage is very short and little typical of *Psychropotes,* and the lateral appendages are small and united by a web, instead of being large and independent, as they normally are in the genus *Psychropotes;* finally the deposits are of the type which is characteristic of *Benthodytes* and not the kind which we find in *Psychropotes* and *Euphronides.*

Benthodytes janthina v. Marenzeller

B. janthina v. Marenzeller, 1893, p. 10, pl. 2, fig. 3. Grieg, 1921.

Incompletely known. Characterized by its dark color and four pairs of large dorsal appendages, beside some smaller pairs (their size can always be estimated when their ampullae are examined on the inner side of the body wall). Judged by its outer shape it seems to belong to the same group as *B. lingua* Perrier. The spicules were partly broken in the type, but besides the simple spinous rods, some were found which seemed to be fragments of cross-shaped bodies with outer projection.

Type locality.— Off the Azores.

Type.— Monaco.

Distribution.— Off coast of Morocco and Bay of Biscay (Grieg, 1921).

Depth.— 2,258–4,700 m.

Not yet reported from the western part of the Atlantic Ocean.

Euphronides Théel

Syn. *Triconus* Hérouard (partim).

Diagnosis.— Body more or less depressed, especially anteriorly. Skin gelatinous. Mouth and anus ventral. Tentacles increasing from 10–18

during growth. Dorsal side with 4–6 pairs of papillae, placed on the anterior third of the body; the hindmost of these papillae are usually much larger than the anterior. Dorsal unpaired appendage is usually placed at a considerable distance from the posterior end. Tube feet in a double row along the midventral ambulacrum; the lateral are small and numerous, united by a web to a narrow brim. Deposits dorsally, four-armed bodies with outer conical central projection and 4 large conical spines, placed at the bases of the long, inwardly curved arms; ventrally, the deposits are smaller, flatter and with the central projection usually absent or much reduced and the basal spines as mere vestiges.

Type species.— *E. depressa* Théel.

Key to the species known to occur in the Atlantic Ocean

1. Deposits with relative short arms; outer projection ending in four backwardly directed spines, resembling an anchor. Tentacles 15 (imperfectly known) . . . . *E. anchora* Hérouard
1. Deposits with long slender arms, more or less strongly arcuated; outer projection conical, exceptionally divided into two outwardly directed spines, but never anchor-like. Tentacles increasing in number to 18 (or 20?) . . . 2
2. Usually five pairs of dorsal appendages; the posterior pairs being very large, especially the hindmost. Dorsally, small and large four-armed bodies, 0.28–0.68 mm. in diameter, with large well-developed outer projection; and large basal spines besides other well-developed spines along the arms; ventrally, deposits much smaller, outer projection usually absent, and spines small. Color brownish . . . . *E. cornuta* Verrill
2. Usually four pairs of dorsal appendages, of which the hindmost pair alone is large 3
3. Dorsal deposits very large, about 1 mm. in diameter; the spines along the arms relatively fine and small except the basal spine; ventral deposits small and very numerous, with many small spines along the arms, no outer projection. Color whitish to rose-colored . . . . *E. talismani* Perrier
3. Dorsal deposits intermediate in size between those of *E. cornuta* and *E. talismani*, about 0.55–0.95 mm. in diameter; the ventral deposits very scattered, almost smooth, and smaller than in any other species. Color dark violet . . . . *E. violacea* Perrier

Euphronides cornuta Verrill

E. cornuta Verrill, 1884, p. 216; 1883, p. 538, pl. 10, fig. 32; pl. 12, figs. 33, 33a.
E. depressa Théel, partim, 1882, p. 94, pl. 26.
E. depressa var. minor Théel, 1886a, p. 2.

E. auriculata Perrier, 1895, p. 902; 1901, p. 434, pl. 13, figs. 1, 2; pl. 20, figs. 12, 13. Grieg, 1921, p. 8.

About 10 specimens examined

The type specimens from off Delaware and off Nantucket vary much in size; those from the first locality seem to be full grown and are about 19 cm. long, those from the latter are only 6–7 cm. long.

Most of the animals are well preserved, and show perfectly the typical characters of the genus; the flattened ventral side with the brim, which is large anteriorly and narrow along the sides and posteriorly; the ventral mouth is in no case surrounded by more than 18 broad tentacles; a double row of completely retracted feet is developed on the midventral ambulacrum and almost reaches the mouth. Dorsally, we find anteriorly 3 pairs of small papillae and behind these a pair of much larger and finally a pair of very large ones; more posteriorly we find the unpaired dorsal appendage which is very variable in form and size, according to its state of contraction. The color of the animals seems invariably to be a dull brown, darker on the appendages and the tentacles.

Internally we have the typical delicate calcareous ring composed of bundles of rods; a ventrally placed Polian vesicle, a very short, wide stone canal which opens dorsally, and a distinct muscle stomach; intestine partly lost in the specimens examined; musculature broad, peculiarly tapering toward the oral end; this holds especially for the ventrolateral muscle bands. The genital organs are developed as two long stems closely covered with short bundles of fertile tubes.

Deposits.— Dorsally smaller and larger four-armed deposits with strong outer projection and strong basal teeth; the other teeth are also well developed; ventrally much smaller but still spinous, cross-shaped rods, which usually lack the outer projection and have very small remnants of the basal spines. In the tentacles simple, strongly spinous rods.

Type locality.— Off Delaware, "Albatross" station 2,037; depth 1,731 fathoms.

Distribution.— Coast of New England; coast of Morocco and off the Canary Islands and Gibraltar. Depth 1,710–3,470 m.

Euphronides violacea Perrier

E. violacea Perrier, 1896, p. 102; 1901, p. 438, pl. 20, fig. 14.
E. depressa var. *minor* (partim), Théel, p. 2.
Benthodytes assimilis Théel, 1886a, p. 3.

The specimens are not well preserved, but it is evident that they very much resemble the preceding species, but have only 4 pairs of dorsal paired papillae, and the posterior pair of these is not remarkably large; the most striking feature is the reddish violet color. The deposits are very much like those found in *E. cornuta;* the best distinguishing character is the spicules in the ventral integument; they are very scarce, almost flat and smooth and only a little more than half as large as those found in *E. cornuta.*

Type locality.— Coast of Morocco and between Azores and Europe; also from Bequia and Gulf of Mexico.

Depth.— 1,180–4,060 m.

Euphronides talismani Perrier

E. talismani Perrier, 1901, p. 441, pl. 20, fig. 15.

At present not known from any locality in the western part of the Atlantic Ocean but it will probably be found there.

It is distinguished from the two other species by its delicate white to rose-colored integument and its much more spinous surface; its spicules are dorsally slightly larger and more slender and delicate than in the two other species; the spicules in the sole also seem to be larger and more spinous.

Type locality.— Off the Azores; depth 2,220 m.

Euphronides anchora Hérouard

E. anchora Hérouard, 1912, p. 6, fig. 5; 1923, p. 103, pl. 1, fig. 28; pl. 6, fig. 3.

Only the imperfect type specimen is known.

Type locality.— 31° 45′ 30″ N., 42° 42′ 30″ W. Depth 3,465 m. ("Princess Alice"). A locality remarkably far from the coast.

Psychropotes Théel 1882

Diagnosis.— Body more or less flattened anteriorly, where the mouth anteriorly is overhung by a broad brim, formed by numerous dorsal appendages, united by a web. Mouth and anus ventral. Tentacles 10–18. Ventral appendages: in midventral radius, numerous small pedicels, arranged in a double row; laterally few, large conical appendages, posteriorly a few small ones, indistinctly united by a web. Dorsally small insignificant papillae, and posteriorly a large unpaired appendage, tail-like, placed near the posterior part of the back. Deposits

strong, cross-shaped bodies with spines and large outer central projection and smaller cross-shaped bodies with central spine reduced, resembling those found in Euphronides.

Type species.— *P. longicauda* Théel.

At present 3 species have been collected in the eastern Atlantic Ocean, none of them, however, taken by the "Albatross" or "Blake"; they may all be expected in the western part of the Atlantic.

Key to the three Atlantic species

1. Midventral radius devoid of appendages (?) .... *P. grimaldi* Hérouard
1. Midventral radius with a double row of small pedicels 2
2. Deposits dorsally of two kinds; in the outer layer they are large, four-armed, with strong outer spinous projection with the basal spines on the arms almost as large as the central projection; inner layer, simple crosses, spinous, but without central projection and with relatively short arms. *P. buglossa* Perrier
2. Deposits dorsally only of one kind, relatively small four-armed bodies with spinous, arcuated arms and central projection and basal spines relatively short .... *P. fucata* Perrier

P. grimaldi Hérouard, 1896, p. 167, fig. 2; 1902, p. 25, pl. 3, figs. 1, 2.

Type locality.— Azores; depth 4,020 m.

P. buglossa Perrier, 1896, p. 902; 1901, p. 445, pl. 13, figs. 3, 4; pl. 20, figs. 16–28. Hérouard, 1923, p. 105, pl. 1, fig. 32; pl. 6, fig. 2.

Type locality.— Coast of Morocco; depth 2,210–5,005 m. ("Talisman").

Also from Bay of Biscay ("Princess Alice").

P. fucata Perrier, 1896, p. 901; 1901, p. 453, pl. 20, figs. 29–30.

Type locality.— Between Azores and France ("Talisman"); depth 4,165 m.

CYCLIONIDAE Hérouard 1923

Diagnosis, Hérouard, p. 85.—Elasipoda, characterized by at least 12 gigantic appendages which belong not only to the dorsal radial canals, but also to the lateroventral canals, and are arranged like a collar; in some cases this collar is united ventrally so that it forms a complete crown, which looks like a second crown of tentacles. The tentacles are 12–20 in number, peltate, with divided terminal ends. The integument is absolutely devoid of deposits.

The family is divided into two groups *Reptantia* with the two genera

Enypniastes and *Európlastes*, both Indo-Pacific forms, and *Natantia*, with the single genus *Pelagothuria*, which is represented in both the Atlantic and Indo-Pacific Ocean, but not yet known from the western part of the Atlantic Ocean; only one species is known from the Atlantic Ocean.

PELAGOTHURIA BOUVIERI Hérouard

P. bouvieri Hérouard, 1906, p. 1–6, fig. 1; 1923, p. 94, pl. 6, fig. 1.

Type locality.— 31° 38′ N.; 42° 38′ W. Between Azores and Africa. Surface.

For further information concerning these aberrant forms, see Hérouard 1923, and Ekman 1926, also Gilchrist, 1920, p. 373.

ELPIDIIDAE

ELPIDIINAE Ekman 1925

Diagnosis.— Most of the deposits are pointed rods or derivates of these. Four-armed rods are not present. Cloaca usually with caecal appendage.

Four of the genera recognized at present are Atlantic. None of them have as yet been reported from the western part of the Atlantic Ocean, but they are likely to occur there.

Key to the genera known from the Atlantic Ocean

1. Calcareous deposits in the shape of slender rods, slightly spinous with three long, straight, pointed arms in some distance from their ends. Arctic genus. *Elpidia* Théel (partim)
1. Calcareous deposits simple, straight or curved or three-armed.
2. Ten pairs of dorsal appendages .... *Irpa* Danielssen and Koren
2. At most 3 pairs of dorsal appendages.
3. Three-armed rods; also wheels or C-shaped bodies, or both *Periamma* Perrier
3. No three-armed deposits.
4. Spinous rods and reticulated plates .... *Kolga* Düben and Koren
4. Spinous rods and C-shaped bodies .... *Ellipinion* Hérouard

ELPIDIA Théel

Diagnosis.— Ten tentacles; lateroventral ambulacra, with large pedicels; dorsal side with papillae arranged in pairs. Deposits, slender,

straight rods with 3 straight arms diverging from one point near each end; in some cases also small hat-like wheels.

Type species.— *E. glacialis* Théel.

According to Hérouard's rearrangement (1923) of the Elpidinae, this genus contains only one specimen. It is, however, a question whether it really is identical with the specimen which Théel mentions from the Southern Ocean which has somewhat deformed, partly dissolved spicules and lacks the small hat-like wheels. I feel almost sure that a revision will show that the two specimens belong to different species. The typical North Atlantic *E. glacialis* seems never to pass the ridge which separates the Arctic water from the North Atlantic area.

Irpa Danielssen and Koren 1877

Diagnosis (translated), with some additions.— Body almost cylindrical, bilateral. Mouth almost terminal; anus posterior; ten short fingerlike laciniated tentacles; along the sides of the body 9 pairs of stiff nonretractile feet, and 3 pairs of similar feet round the posterior part of the body. Two rows each, with 4 papillae, and between them a pair of papillae is found in the nuchal region on the dorsal side. Deposits, rods, straight or curved, simple or branched.

Type species.— *I. abyssicola* Danielssen and Koren

Exclusively Arctic. Only one species is known.

I. abyssicola Düben and Koren, 1878, p. 257, pl. 4. Ludwig, 1901, p. 141 (complete list of references). Hérouard, 1923, p. 82.

Kolga Düben and Koren 1879

Diagnosis, translated.— Body bilaterally developed. Oral disk with 10 tentacles and ventrally directed. Anus dorsal. A projecting collar on the anteriormost part of the back, provided with papillae; just in front of the collar we find two openings, one for the genital organs and one for the stone canal. Pedicels arranged laterally and posteriorly. The sexes are separate. No appendix to the intestine.

Type species.— *K. hyalina* Düben and Koren.

Arctic Sea. Also from between Iceland and Norway.

Key to the two known species

1. Dorsal appendages placed on a common, slightly curved ridge. Seven to nine pedicels on each side. Rosettes and plates beside the C-shaped bodies and straight rods. Five rods in each piece of the calcareous ring.
K. hyalina Düben and Koren

1. Dorsal appendages arranged in two parallel series. Eight to nine pedicels on each side. No rosettes and reticulated plates. Ten rods in each piece of the calcareous ring . . . . *K. nana* (Théel)

K. nana Théel, 1882, p. 39, pl. 2, figs. 3, 4; pl. 33, figs. 1, 2; pl. 34, fig. 5; pl. 36, fig. 25; pl. 42, figs. 5, 8. Ludwig, 1898, p. 12; 1901, p. 140.
Elpidia nana Théel, 1879, p. 15, pl. 2, figs. 20–22.

Type locality.— 42° N., 64° W. Probably also from the Antarctic part of the Indian Ocean (ab. 61° S., 80° E.).

K. hyalina Düben and Koren, 1879, p. 83–106, pls. 1, 2; 1882, p. 3–20, 80, pls. 1–3. Théel, 1882, p. 39. Ludwig, 1898, p. 12; 1901, p. 140. Hérouard, 1923, p. 82.

Ellipinion Hérouard 1923

Syn. *Scotoplanes* Théel (partim)

Diagnosis, from Hérouard.— Elpidids, with spicules of the 3-armed type, with 2 other kinds of deposits in the integument, namely straight rods with spinous ends and C-shaped bodies, simple or with a vestige of a third arm as a small apophysis on the convex side of the spicule. Body egg-shaped, the anterior end tapering. Nuchal group of dorsal appendages present, usually forming an asymmetrical deformation.

Type species.— *E. delagei* Hérouard.

Key to the species known from the Atlantic Ocean

1. Pedicels 8 in number on each lateral ambulacrum. Dorsal side with two pairs of small processes, united to a transversal ridge and behind these a pair of very small papillae . . . . *E. papillosus* (Théel)
1. Pedicels more than 8 in each lateral ambulacrum.
2. Ten to eleven pedicels in each later ventral ambulacrum. Anteriorly some very small dorsal papillae . . . . *E. albida* (Théel)
2. Twelve lateroventral pedicels. Dorsally 3 pairs of equally large papillae, placed in two rows parallel to the longitudinal axis of the body. *E. delagei* Hérouard

E. papillosus (Théel) (Scotoplanes).

Type locality.— 36° 44′ S., 36° 16′ W.; depth 4,823 m.

E. albida (Théel) (Scotoplanes).

Type locality.— 36° 48′ S., 19° 24′ E.; depth 3,473 m.

E. delagei Hérouard.

Type locality.— Off the Azores; depth 1,165–1,385 m.

None of the species have yet been taken in the western part of the Atlantic Ocean.

Perriamma Perrier 1901

Diagnosis, Perrier, 1901, p. 417.— Body slightly elongate or egg-shaped, at most two and a half times as long as broad; 10 tentacles. Dorsal side on its anterior part presenting a transversal row of 3–4 papillae sometimes distinct, sometimes adjoining, sometimes fused into a voluminous transverse four-lobed appendix.

Immediately behind these papillae a small number of isolated very small papillae are found on the dorsal ambulacra. Ventral sides each with a lateral row of pedicels which usually are developed behind the middle part of the body. Triradiate bodies, together with sigmaes.

Type species.— *P. roseum* Perrier.

Key to the species known from the Atlantic Ocean

1. Six posteriorly placed feet; 2 pairs of dorsally placed small papillae not united by a web; a smaller one is found posteriorly (only on one side in the type) *Perriamma ludwigi* (v. Marenzeller)
1. Nine feet placed in almost the entire length of the ventral side; dorsal papillae united to a veil.
2. Arms of triarmed rods about 93–174 μ in length; besides large spinous simple or dichotomously divided rods . . . . *P. roseum* Perrier
2. Arms of triarmed rods about 31 μ in length; apparently no simple large rods present . . . . *P. furcata* (Hérouard)

Perriamma ludwigi (Kolga) (v. Marenzeller), 1893, p. Hérouard, 1923, p. 83.

Type locality.— Eastern Mediterranean; depth 1,293 m.

Periamma furcatum (Kolga) Hérouard, 1899, p. 171, fig. 2; 1902, p. 40; 1923, p. 91, pl. 3, fig. 7; pl. 6, figs. 4–10; pl. 8, fig. 17.

Type locality.— Near the Azores; depth 1,846 m.

Periamma roseum Perrier, 1896, p. 901; 1901, p. 419, pl. 13, figs. 10–12; pl. 20, figs. 1–11. Hérouard, 1923, p. 91.

Type locality.— Between Azores and Europe; depth 4,060–5,005 m. Also from Bay of Biscay.

Peniagoninae Ekman 1925

Diagnosis.— The dominant type of calcareous deposits is 4-armed, with 1–4 outer projections, derived from primary crosses.

Six genera are recognized at present (see Hèrouard, 1923); only two of these are known from the Atlantic Ocean.

Key to the two genera

1. Dorsal appendages small or large, usually developed as a veil, but this is never forward projecting as if it was a prolongation of the body; body not especially flattened . . . . *Peniagone* Théel
1. Dorsal appendages united to an enormous veil, which projects forward as a prolongation of the body; body extremely flattened . . . . *Scotanassa* Théel

PENIAGONE Théel (partim) 1882

Revised diagnosis, based upon Hérouard's results.— Lateral feet more or less numerous, sometimes absent on the part of the ambulacra which is nearest the mouth. Distinct nuchal thickening with 2 anterior pairs of papillae, which are either free or united by a larger or smaller web into a veil; 1 or 2 posterior pairs of atrophying papillae may be present behind the veil.

Deposits, derived from primary crosses with 4 more or less strongly inward bent arms and 4 outer, short to long projections; deposits smooth or covered with fine spines.

Type species.— *P. wyvilli* Théel.

Type in the British Museum.

The "Albatross" expeditions secured only 2 poorly preserved specimens of *Peniagone*, from the West Indian region, and I have been unable to identify them.

At present we know 9 species from the Atlantic Ocean, most of which may be expected from the West Indian region and off the coast of the United States, and a key has therefore been given, as well as references to the literature.

Key to the Atlantic species of Peniagone

1. Deposits in the body wall of two kinds; dorsally the usual type, with four inward bent arms and four slender outwardly directed projections, all completely smooth; ventrally, simple cross-shaped, robust, and very spinous rods. Dorsal veil large; number of ventral feet unknown. *P. vexillum* Perrier
1. Deposits in body wall all of the typical form, both dorsally and ventrally; a few simple cross-shaped bodies may also occur among the typical, usually located in the deeper layer of the integument. (Similar rods are often present in tentacles and in appendages.) 2
2. Short, almost ovoid forms, with appendages distributed in almost the entire length of the lateral ambulacra 3
2. More or less elongate forms, with a distinct diastema between the oral disk and the pedicels 6

3. Veil very small, only a basal web uniting the four small papillae; a third pair of very small papillae is placed behind the veil. In each lateral ambulacrum 9 appendages, slightly decreasing in size toward the anal end. Deposits of almost equal size dorsally and ventrally, large and robust, with relatively short outer projections, covered with numerous spines, especially toward the ends of the arms and the outer projections. In tentacles, simple spinous rods .... *P. porcellus* Perrier
3. Veil well developed to very large 4
4. Veil well developed but not forming an enormous anterior hump, or overhanging brim; it is composed of two pairs of papillae which are almost completely united by the web, only the tips are free; the median are very closely placed; a single papilla is placed on each side at the base of the veil. Five pairs of large pedicels in each lateral ambulacrum, arranged in groups of two anterior and three posterior. Deposits small and delicate, with few spines; arms of deposits only slightly bent; in the deeper layer also simple cross-shaped rods .... *P. obsoleta* (Hérouard)
4. Veil enormous, forming a large anterior hump-like portion or an overhanging brim 5
5. Veil deeply cleft into four parts, two pairs of small papillae placed behind the basis of the veil. Six large pedicels on each side, almost reaching the oral opening; 2–3 very small appendages are found near the posterior end. Deposits of the usual type, large and strongly spinous; many are developed as cross-shaped bodies, some are irregular with 5 arms, etc. In the tentacles and appendages, simple or cross-shaped rods . . *P. wyvilli* Théel
5. Veil flattened, overhanging the oral end as a large brim, laterally developed as a narrow brim, anteriorly not cleft. Seven pedicels along each side of the ventrum, the two hindmost rather small. Deposits with almost straight, smooth arms. Outer projections considerably longer than the arm itself .... *P. foliacea* (Hérouard)
6. Veil large, forming a conical hump on the anterior part of the body, not incised; number of accessory papillae not known. Five to six pairs of pedicels, widely spaced, placed on the two posterior thirds of the body. Deposits of the usual type; arms slightly bent, with minute spines. Color dark .... *P. lugubris* Théel
6. Veil small.
7. Veil divided into two parts to the basis, each part composed of two papillae. Nine pedicels on each side, of almost equal size, placed on the posterior two thirds of the body; also three small appendages, united by a web, are found round the posterior end. Deposits of the usual type, but the outer projections on the ventral deposits are distinctly much shorter than those on the dorsal deposits; finely spinous .... *P. azorica* v. Marenzeller
7. Veil either undivided or divided into four parts 8
8. Veil deeply incised, divided into two parts; 2 pairs of posterior basal papillae are present. Five pairs of equally large pedicels present on the posterior half of the body, and also 2–3 very small ones beneath anus. Deposits

of the typical form, outer projections only slightly shorter than the arms; covered with spines . . . . *P. ferruginea* Grieg

8. Veil not divided, margin only serrate, composed of 3 pairs of papillae, the basal pair also united to the web. Five pairs of large pedicels and 4 pairs of much smaller, posterior ones. Well-developed diastema. Deposits with outer projections as long as the arms and slightly stouter and more spinous; arms elegantly curved with very delicate spines, often almost smooth . . . . *P. islandicus* sp. nov.

P. obsoleta Hérouard, 1899, p. 170, fig. 1; 1902, p. 41, pl. 6, figs. 11–15; pl. 8, fig. 16, 18; 1923, p. 80.

Between Azores and Portugal; depth 4,360 m.

P. wyvilli Théel, 1882, p. 42, pl. 10, figs. 3, 4. Perrier, 1901, p. 426. Hérouard, 1923, p. 80. Grieg, 1921, p. 8.

From "Challenger" station 271, 0° 33′ S., 151° 34′ W.; depth 2,425 m. Also taken by "Michael Sars" (Grieg, 1921).

P. foliacea Hérouard, 1912, p. 3, figs. 3, 4; 1923, p. 86, pl. 1, fig. 31; pl. 9, figs. 1, 2.

Off Madeira, depth 4,275 m.

P. lugubris Théel, 1882, p. 44, pl. 10, fig. 1. Hérouard, 1923, p. 80.

From "Challenger" station 104 (lat. 2° 25′ N., long. 20° 1′ W.; depth 2,500 fms.).

P. azorica v. Marenzeller, 1893, p. 12, pl. 1, fig. 4; pl. 2, fig. 5. Hérouard, 1902, p. 42, pl. 6, figs. 21–26; 1923, p. 80.

Near Azores (l'Hirondelle), depth 2,870 m.; also from south off Iceland ("Ingolf").

P. ferruginea Grieg, 1921, p. 7, pl. 1, figs. 4–6, text-fig. 3.

"Michael Sars," depth 2,800–3,000 m.

P. islandicus Deichmann.[1]

South off Iceland, "Ingolf" station 18, 61° 44′ N., 30° 29′ W.; depth 1,135 fms.

P. vexillum, Perrier, 1900, p. 118; 1901, p. 429, p. 13, fig. 6; pl. 19, figs. 24, 25. Hérouard, 1923, p. 80.

Locality unknown.

P. porcellus Perrier, 1896, p. 901; 1900, p. 118; 1901, p. 426, pl. 13, figs. 7–9; pl. 19, figs. 15–23. Hérouard, 1923, p. 80.

Between Azores and France; depth 4,060 m.

[1] [Description to be supplied later.]

Scotoanassa Théel 1882

Diagnosis, partly after Hérouard, 1923, p. 79.— Lateral feet restricted to the posterior part of the body, leaving a very large empty diastema between them and oral part. Two pairs of dorsal papillae are present united to a large veil, and directed forward, placed in the same plane as the rest of the body. Extremely flattened form in adult condition. Anus dorsal.

Deposits.— Four-armed with four outer projections.

Type species.— *S. diaphana* Théel.

Only one species is at present known from the Atlantic Ocean, as yet unreported from the western part.

Scotoanassa translucida Hérouard

S. translucida Hérouard, 1899, p. 172, fig. 3; 1902, p. 43, pl. 3, figs. 4–6; pl. 6, figs. 17–20; 1923, p. 88, pl. 3, figs. 7, 8; pl. 4, fig. 4.

Four pairs of conical pedicels or papillae, placed on the posterior rounded portion of the body. Deposits strong, of the typical form; the terminal part of the arms and projections are covered with fine spines.

Type locality.— Near the Azores; depth 4,000–5,000 m.

Also off the north coast of Spain and west of Ireland.

This form is interesting because Hérouard (1923) describes some 0.5 cm. long specimens which apparently are at the end of their larval period, resembling the "pentacta stage" described in the Dendrochirota and Synaptidae.

DENDROCHIROTA Grube 1840

Diagnosis.— Appendages present; tree-shaped tentacles; tentacle ampullae absent or small. Retractor muscles present. Respiratory trees present, sometimes connected with the alimentary canal through a rete mirabile. Stone canal hanging free into the body cavity. Mesentery of the posterior intestinal loop in left or right interradius. Genital organs in tufts on both sides of dorsal mesentery. No Cuvierian organs. Deposits of various kinds, as baskets, buttons, plates, tables and rods.

In the western part of the Atlantic Ocean occur the following genera: The very closely related and not well-separated genera *Cucumaria*, *Thyone*, *Pentacta*, *Pseudocolochirus* and the sharply defined *Echinocucumis* and *Sphaerothuria*, all belonging to the family *Cucumariidae;* further the well-defined genera *Psolus* and *Thyonepsolus*, belonging to the family *Psolidae;* and finally the heterogeneous group *Phyllophoridae*,

which probably will be divided into several genera; at present only the genus *Phyllophorus* is known from the western Atlantic.

Only a provisional diagnosis has been given for *Cucumaria* and *Thyone*, as the line between these two genera at present is not established. Specimens with few appendages are usually referred to *Cucumaria*, with many to *Thyone*. In the future they will become divided into several genera, with the calcareous deposits as well as the general anatomical features as the distinguishing characters.

In this paper is not included the Atlantic form of *Cucumaria abyssorum* Théel, taken in deep water off the Azores (Hérouard) and south of Iceland ("Ingolf" expedition, not published) (see Mortensen, 1927, p. 396, footnote 2). The species has not yet been taken in the western part of the Atlantic Ocean.

Key to the genera of Dendrochirota which are known from the western part of the Atlantic Ocean

1. Ventral side flattened into a distinct sole 2
1. Ventral side not flattened into a distinct sole 3
2. No appendages on the dorsal side except the papillae around anus and on the introvert; dorsal side covered by scales, naked or with grains. *Psolus*
2. Several appendages on the dorsal side, which is covered by scales and an outer thick layer of various deposits, partly concealing the scales. *Thyonepsolus*
3. Tentacles more than 10 . . . . *Phyllophorus* 4
3. Tentacles not more than 10 5
4. Tentacles in 2 circles arranged in pairs; the pairs in the inner circle much smaller than the pairs in the outer circle . . . . [*Thyonidium*]
4. Tentacles in 2 circles, not arranged in pairs; the inner circle contains 5 tentacles, somewhat smaller than those in the outer circle, which are unequal in size . . . . [*Phyllophorus*]
5. Body globular, covered by scales, with large projecting spine 6
5. Body not globular, covered by scales 7
6. Spire mostly eccentrically placed; scales consist of perforated simple plates. *Echinocucumis*
6. Spire centrally placed; scales consists of plates with several layers of meshwork . . . . *Sphaerothuria*
7. Appendages numerous all over the body . . . . *Thyone*
7. Appendages not numerous all over the body 8
8. Dorsal appendages well developed, not few and papilliform . . . . *Cucumaria*
8. Dorsal appendages and those around oral and anal opening few and papilliform 9
9. Skin soft with few deposits . . . . *Pseudocolochirus* gen. nov.
9. Skin rigid with numerous deposits . . . . *Pentacta*

PHYLLOPHORUS Grube 1840

Diagnosis.— Feet uniformly distributed; tentacles normally 20, arranged either in 5 outer larger pairs and 5 inner pairs, or in 2 indistinctly separated circles, with 15 tentacles in the outer circle and 5 slightly smaller ones in the inner.

Deposits, usually tables, with 4 or 2 rods in spire; in some species the deposits are reduced with advancing age; large end-plate in the feet, but no supporting rods; often rosettes in introvert; perforated plates on tables occur in some species.

The group might possibly be split into two: *Thyonidium*, with tentacles distinctly in alternating pairs, and *Phyllophorus* with 15 outer and 5 inner tentacles, but our knowledge about these animals is still so imperfect that such a division is not at present desirable.

Key to the species of Phyllophorus known from the west Atlantic region

1. Deposits: thick, discoidal bodies, with serrate margin and few (about 4) perforations, and a number of minute conical knobs. Short, stout radial projections on calcareous ring . . . . *Ph. dobsoni* Bell
1. Deposits: tables or plates derived from tables 2
2. Table with 4 equally large central holes, and usually 4 distinct rods in spire, occasionally only 3, or spire entirely reduced 3
2. Tables with 2 equally large central holes; disk more or less elongate; 2 rods in spire, sometimes reduced to 4 knobs. 6
3. Calcareous ring high; radials squarish, with short posterior prolongations; interradials overlapping the radials, posteriorly rounded, anteriorly tapering. Tables with squarish disk with about 12 holes in the margin. In the introvert more irregular table and rosettes. *Ph. seguroensis* sp. nov.
3. Calcareous ring, low, simple 4
4. Deposits: tables with regular disk, with about 8 holes in margin. Tentacles not in pairs . . . . *Ph. conchilegum* Pourtalès
4. Deposits: tables with irregular disk; deposits often reduced, except in the introvert. Tentacles in pairs 5
5. Tables delicate, with high fragile spire with 3 or 4 rods, ending in few teeth. *Ph. communis* (Forbes)
5. Tables robust, with low spire ending in numerous teeth. *Ph. pellucidum* (Fleming)
6. Margin of tables dentate, spire often reduced to 4 low knobs. *Ph. occidentale* Ludwig
6. Margin of tables smooth 7
7. Long, well-developed tails on calcareous ring; usually 2 large and 6 slightly smaller holes in disk of tables . . . . *Ph. destichadus* sp. nov.

7. Short tails on calcareous ring, interradials overlapping the radials........8
8. Smooth, oval outline of disk; 8 large holes and 2 small ones. Spire well developed..*Ph. parvum* Ludwig
8. Undulated outline of disk; 4 holes. Rudimentary spire..*Ph. tritus* (Sluiter)

Phyllophorus dobsoni Bell

Phyllophorus dobsoni Bell, 1883, p. 60, p. 15, figs. 5, 5a, b. Lampert, 1885, p. 179. Théel, 1886, p. 151.

Redescription of the type.— A large specimen, about 8 cm. long, barrel-shaped; mouth and anus terminal, dorsally directed; feet conical, but with well-developed end plate, distributed over the entire body, more sparingly dorsally. Twenty slender tentacles, with 15 in the outer and 5 slightly smaller in the inner circle, not much branched. Color brownish; whitish where the pigment is rubbed off.

Calcareous ring high, very solid and with short, stout posterior prolongations on the radials; interradials with long anterior tooth and slightly excavated posteriorly. According to Bell, two Polian vesicles are present; they seem to have been torn off; one dorsally attached stone canal. Muscle stomach seems not to be well developed; intestine very long, collapsed, incomplete. Well-developed respiratory trees, laterally attached. Muscle bands strong, projecting like ridges into the body cavity. Two tufts of very numerous genital tubules, filled with eggs, are attached close behind the vascular ring.

Deposits very characteristic: rough, roundish buttons with 4 or more holes, apparently derived from rosettes. Besides these, only well-developed end plates; in introvert rosettes; in tentacles small rods.

At present only known from the Bay of Honduras (Dobson). The unique type is in the British Museum.

Remarks.— It is very likely that this form possesses tables in younger stages.

Phyllophorus seguroensis sp. nov.

Plate 17, figs. 10–13

The 10 specimens examined are 5–6 cm. in length. They resemble very much *Thyone suspecta* and *gemmata* in their outer shape, arrangement of appendages and coloration, but usually some of the feet will be sufficiently expanded to show that they are soft, collapsible, without any supporting rods. Tentacles 20 in alternating pairs; 5 small anal teeth hidden under 5 groups of slender papillae. Skin soft but finely rough to the touch; color brownish with paler appendages, the general effect of the animal is mottled.

Internally a high calcareous ring; radials almost rectangular with a broad, deeply furrowed anterior tooth and a small posterior incision, no true posterior prolongations; interradials overlapping the radials; posteriorly cut off in an almost straight line; anteriorly provided with a long, tapering tooth. Two to three Polian vesicles; a small stone canal; with roundish head, attached in the mesentery; muscle stomach not distinct in the specimen examined; intestine long; the mesentery runs in the dorsal interambulacra, crosses over the left dorsal muscle band just behind the attachment of the retractor, then over the left ventral retractor to the midventral muscle band and runs along its right side to the cloaca; respiratory trees richly branched, placed in lateral interambulacra; musculature fleshy; retractors attached a little anterior to the middle. Genital organs fastened at the same distance from the oral end; they are present as slender tubules in the immature specimen examined.

Deposits.— Regular tables with 4 central holes and about 12 marginal ones; margin often undulated to blunt dentate; spire built up of 4 rods with one cross beam and ends in numerous teeth. End plate large; only the bases of the feet covered with tables; the terminal part is devoid of deposits other than the end plate and therefore collapsible. In introvert tables of more irregular form and small rosettes; in tentacles no deposits in the main stem but several perforated rods in the smaller branches; besides numerous large rosettes.

Type locality.— Porto Seguro, Brazil; also collected by Dr. H. L. Clark from Port Antonio, Jamaica, and Tortugas, Florida, so we may conclude that it is quite a common species in the western part of the West Indian region.

Type in the Museum of Comparative Zoölogy, no. 856.

It occurs near low tide mark, in shallow water.

Phyllophorus conchilegum (Pourtalès)

Plate **17**, figs. 14, 15

Thyonidium conchilegum Pourtalès, 1868, p. 128; 1869, p. 359, 361.

Specimens 3–4 cm. long have been examined, all in a very bad condition for more detailed anatomical study. Tentacles 20, of very unequal size, apparently arranged 15 in the outer and 5 in the inner circle. Feet relatively large and few, scattered without order; integument thin, wrinkled, resembling tissue paper; texture of skin finely rough to the touch; color whitish.

Calcareous ring simple; radials rectangular, high, with broad, deeply furrowed anterior tooth and low posterior prolongation; interradials low with long pointed anterior tooth, and deeply excavated posteriorly. Most other anatomical features not suitable for examination; the retractors are very long, attached near the middle of the body; the genital organs, which are ripe and filled with eggs (taken in May), form short, thick, fingerlike tubes, attached to the body wall, anterior to the middle of the animal.

Deposits.— Regular tables with 4 central holes and smooth thick disk with about 8 marginal holes; spire well developed with 4 rods and one cross bar and ending in numerous teeth. End plate well developed; the tables cover the feet completely and seem thereby to prevent the complete retraction of these. In the introvert, tables and perforated plates; in the tentacles, perforated plates.

Type in the Museum of Comparative Zoölogy, no. 259.

Type locality.— Off Sand Key, Florida, 100–120 fathoms; other specimens are labeled Florida Keys, 174–189 fathoms.

Phyllophorus communis (Forbes)

Plate **17**, figs. 16, 17

Cucumaria communis Forbes, 1841, p. 217, text-fig.
Thyone drummondi Forbes, 1841, p. 223, text-fig. *T. portlocki*, ibid., p. 238.
Thyone commune Düben and Koren, 1844, p. 214, p. 304, pl. 11, fig. 51.
Duodasmodactyla productum Ayres, 1854, p. 244. Stimpson, 1857, p. 17.
Orcula punctata Selenka, 1867, p. 353, fig. 112 (Agassiz, 1851, nomen nudum). Théel, 1886, p. 150.
Phyllophorus drummondi Ludwig (partim), 1901, p. 155.
Thyonidium dübeni Normann, 1868, p. 317.
Thyonidium productum Clark, 1901, p. 494.

Grows to a length of about 15 cm. Slender form; outer appearance varies much with the age of the animal.

Tentacles 20, distinctly arranged in 5 outer large pairs and 5 inner small pairs; tentacles in inner pairs mutually well separated. Feet of medium size, most densely distributed along ambulacra, more thinly scattered in interambulacra, still with a tendency to be absent on a narrow strip of the latter, and different stages of contraction make this character more or less obvious. Skin in young specimens thin, parchment-like, never transparent, and quite leathery in consistency, in old specimens very smooth, thick and fleshy. Color whitish or yellowish; usually the tentacles and some part of the oral end are violet.

Internal features.— A simple calcareous ring without any posterior prolongations; radials with very long squared anterior tooth and irregular incision in the posterior margin; interradials with a pointed anterior tooth, almost as long as the radial tooth. Polian vesicles 1–2 long; a very small stone canal coiled up in the mesentery. Apparently no muscle stomach; mesentery running in the dorsal interambulacra, almost reaching to the cloaca, then running forward to the bases of the retractors, across the two left muscle bands and finally running backward along the left side of the midventral muscle band. Respiratory trees with long, slender secondary branches, laterally placed and almost reaching the attachment of the retractors. Muscle bands relatively thin except in very large, senile specimens, where they are thick and fleshy; retractors almost reaching the middle of the body cavity. Genital organs attached near the middle along a 1 cm. long band (in specimen 10 cm. long); they appeared not quite ripe, and were only a few cm. in length, divided once, near the base.

Deposits.— Only in a very small specimen, tables were found in the body wall; usually they are restricted to the introvert; they have a delicate irregular disk with several holes and a high spire composed of 3–4 slender rods, united near base and top and ending in a few teeth. In old specimens the spire may be completely reduced or deposits may be entirely absent. The feet contain a well-developed end plate in young specimens, but it disappears in older ones, and the pedicles appear as soft, short threads. In the tentacles a few perforated plates or no deposits at all.

Type locality.— Coast of Ireland.

Type not existing.

Quite common along the coast of New England and Newfoundland. Its exact range in European waters cannot be made out at present.

Selenka's *Orcula punctata* is identical with this species, and was recorded from Charleston by mistake; his type specimen was from Eastport, Maine.

About its habits, Ayres says (of *Duodasmodactyla productum*): "This species is found in deep water, but occurs most frequently under stones or buried to a slight depth in gravel near low water mark. In fact, if distinct, it is at least very closely related to their (Düben and Koren's) *Thyonidium pellucidum*."

Remarks.— This species and the following have often been united, and it has for a long time been an open question whether we were dealing with several distinct species or one very variable form (see Ludwig, 1901 and Mortensen, 1910). The conclusion to which I have

finally arrived, after having had the opportunity of examining all the specimens of these forms represented in the United States National Museum, Washington; Museum of Comparative Zoölogy, Cambridge; British Museum, London, and the Zoölogical Museum of Copenhagen, is that Düben and Koren, in 1844, described these two species in a very clear manner and gave excellent figures of the spicules which better than words show the actual differences.

The name *Ph. communis* given by Forbes is to be preferred for *Ph. drummondi* Thompson, which is one year older, because it is evident that Forbes described *Ph. communis*, whereas it may be that Thompson's species was identical with *Ph. pellucidum;* his description is not clear. Forbes regarded as different species (*drummondi, portlocki*) the old and senile specimens of *Ph. communis*, which look very different.

Phyllophorus pellucidus (Fleming)

Holothuria pellucidum Fleming, 1828.
Cucumaria hyalinum Forbes, 1841.
Pentactes pentacta Oersted, 1833.
Orcula barthi Troschel, 1846. Lütken, 1857, p. 9. Duncan and Sladen, 1882, p. 8. Ludwig, 1901, p. 152 (complete list of lit.).
Thyonidium pellucidum Düben and Koren, 1844, p. 217, pl. 4, figs. 15–17; p. 303, pl. 11, fig. 57. Théel, 1886, p. 146.
Phyllophorus pellucidus Ludwig, partim, 1901, p. 153 (complete list of litt.).
Not *Thyonidium conchilegum* Pourtalès, as suggested by Théel (1886, p. 146) with some doubt.

Maximum length seems to be 10–15 cm. Outer aspect very variable, usually tapering, sometimes barrel-shaped; tentacles 20, in 5 outer large pairs and 5 inner small pairs; the 2 tentacles in each inner pair are so closely placed that they may be mistaken for a single, deeply cleft tentacle,[1] and such specimens have sometimes been referred to the genus *Orcula*, with 15 tentacles, which, as far as I can see, has no real existence.

The feet are large, almost uniformly distributed over the body; an indication of a serial arrangement along the ventral ambulacra may be observed in some specimens; skin, when expanded, semitransparent; in old contracted specimens it is thick, soft, opaque in section; color whitish to brownish.

Internal anatomy like that of *Ph. communis*, but the calcareous ring is, even in the oldest specimens, firm, showing no signs of degeneration.

[1] Ljungman 1879, p. 129, and Ludwig 1886, p. 276, have noted this peculiarity.

Deposits.— In young specimens the entire surface is covered with stout tables with large irregular disk and low, strong 3–4 pillared spire ending in numerous strong teeth; the deposits are reduced during age; sometimes they are retained in the introvert, in other cases they disappear completely; end plate large and well developed in young specimens, absent in old.

In young specimens the tables are characteristic enough to separate this species from *Ph. communis;* in old specimens the large feet and the solid, firm and elegantly shaped calcareous ring are the only reliable distinguishing characters.

Type.— Not preserved.

Common in Scandinavian waters, also around Great Britain, the Faeroes, Iceland and Greenland.

Recorded several times from the coast of Labrador; a few small specimens in United States National Museum are labeled "off Newfoundland," and the species may be expected also along the coast of New England.

Phyllophorus destichadus sp. nov.

Plate 18, fig. 3

Two well-preserved specimens, 4–6 cm. long with body slightly curved; a robust form with numerous strong feet almost uniformly scattered over the entire surface; tentacles apparently 17, but most likely some have been lost; they are arranged without order, small and large together. Skin solid, thick, soft to the touch; color brownish to violet; oral and anal ends paler.

Calcareous ring forms a high narrow tube with long rectangular radials with broad anterior tooth and short posterior prolongations; the interradials are slightly shorter, cut off at a straight line posteriorly, and constricted in front to a long tooth which proceeds forward to the same level as the radial teeth. One small Polian vesicle; one small, dorsally embedded stone canal; apparently no muscle stomach, but the intestinal tract was torn off just behind the vascular ring so it may have been present; course of intestine as usual, the third loop runs along the left side of the midventral muscle band. Respiratory trees richly branched, each divided into two large stems, spreading over and attached to the lateral interambulacra and lateroventral muscle band; musculature fleshy, forming narrow ridges in the body cavity; retractors short, attached distinctly in front of the middle of the animal; genital organs form two tufts of very numerous, thin,

closely packed tubules, which are attached near the middle of the dorsal midline. In one of the specimens examined the respiratory trees were deep violet in color.

Deposits.— Tables with oblong smooth disk with 2 large central holes and 3 slightly smaller in each end; spire composed of two rods, ending in 8–12 teeth. End plate well developed; no supporting rods, the tables covering the feet almost to the end plate; in introvert tables of almost the same type, and rosettes; in tentacles small rods.

Type in Museum of Comparative Zoölogy, cat. no. 1,201.

Type locality.— Tortugas, Florida (Clark). Collected in shallow water in eel grass at low tide.

Remarks.— This species belongs in the same section of the genus as *occidentale, parvum*, and *tritus* but is easily distinguished from Ludwig's two species by the tables, and from *tritus* by the calcareous ring being much better developed.

Phyllophorus tritus (Sluiter)

Plate 18, figs. 4–8

Thyone trita Sluiter, 1910, p. 339, text-fig. Ea, c. Deichmann, 1926, p. 24.

One specimen 3 cm. long was examined; 18 tentacles of unequal size could be counted, possibly 2 small ones have escaped my attention; they are very soft and very difficult to count. Feet numerous, not retracted, uniformly distributed over the entire surface; color grayish brown, skin soft to the touch. Internal anatomy as Sluiter describes it; calcareous ring with short, stout posterior prolongations on the radial pieces; interradial pieces slightly overlapping the radials, with broad anterior tooth, posteriorly slightly undulated, broadest at the middle.

Genital organs as divided tubules, 0.5 cm. long, attached near the middle of the body on a short genital basis. Other features as in the other members of the genus.

Deposits, in spite of the soft skin, rather numerous, developed as oval, four-holed tables with smooth to scalloped margin, often with 4 small accessory holes; spire two-pillared, very low, practically absent and with a few long teeth at the end of each of its 2 short pillars. In the feet a large end plate, no supporting rods at all, only a few typical tables. In the introvert, tables with smooth outline and usually 4 large and 4 small holes; spire somewhat higher and better developed; in tentacles rosettes and a few small delicate rods with a few perforations or a single hole in each end.

Type locality.— Tortugas, Florida.

Type in Berlin.

Also recorded from English Harbour, Antigua (W. K. Fisher).

Remarks.— I have not seen Sluiter's specimens, but my suspicion was awakened (after I had worked out all the West Indian species of *Phyllophorus* and *Thyone*), because Sluiter says nothing about supporting rods in the feet; their absence being a most unusual feature in *Thyone*. Through the kindness of Dr. Dayton Stoner of the University of Iowa, I have had the opportunity to reëxamine the specimen which I previously had determined as *Thyone trita*, and when the oral tract was opened my suspicions were confirmed by the presence of at least 18 tentacles.

PHYLLOPHORUS OCCIDENTALIS Ludwig

Plate **18**, figs. 1, 2

Thyonidium occidentale Ludwig, 1885 (Nachtrag).
Thyone constituta Sluiter, 1910, p. 340, text-fig. E. Deichmann, 1926, p. 24.

Translation of Ludwig's description.— "The specimen is about 4 cm. in length and measures 2 cm. in diameter at the middle; the color is uniformly brown. A serial arrangement of the feet is indicated along the radii, and they are also spread uniformly over the entire body. The tentacles are arranged in a characteristic manner, namely 5 larger pairs 8–10 mm. long, alternating with 5 smaller pairs, only 1.5–3 mm. long. In the skin, which is rather soft to the touch, we find numerous deposits which are all of the same type; they are in the form of tables; the disk is well developed with scalloped margin (recalling those of *Ph. holothuroides*), whereas the spire is reduced to 4 low spines, united at their bases; the average length of the deposits is 0.045 mm., height 0.017 mm.

The calcareous ring is 7 mm. in height and composed of 10 pieces, 5 radials and 5 interradials; posteriorly a small piece is intercalated between radials and interradials; the latter are irregular, diamond-shaped; the radials are anteriorly provided with an incision and posteriorly prolonged into two short tails, composed of small calcareous plates. Two Polian vesicles are attached at left to the water vascular ring, one of these being 16 mm. long, the other 8 mm. The single stone canal is attached to the mesentery and ends in a globular head; the first part of it is coiled into several short loops; the head of the stone canal is 8.5 mm. away from the point of issue of the stone canal; the retractors are rather well developed and inserted between the first and second third of the body length, the introvert not being counted. The

long (about 24 mm.), delicate, unbranched genital organs are numerous and form a large tuft on each side of the mesentery; they are attached near the middle of the body."

Type locality.— Surinam.

In the Museum of Comparative Zoölogy several specimens are present which evidently belong to this species and are also identical with Sluiter's *Thyone constituta,* in which latter form the actual number of tentacles has been overlooked. It would be extraordinary to find a *Thyone* with deposits derived from tables but lacking supporting rods formed like elongate tables. Moreover, Sluiter's figure of the calcareous ring corresponds exactly with Ludwig's description.

Very little can be added. Examination of several specimens shows that the posterior accessory plates, belonging to the interradials, are not always well separated in all parts of the ring. Other anatomical features, as in other species of *Phyllophorus,* belonging to this group. The end plate is well developed and a few, very delicate rods may be found in some of the feet. In the introvert we find tables of the same type as those in the body wall; and, moreover, rosettes; in the tentacles tables; in the stem and in the remaining part, rosettes and very delicate rods.

Ranges from Porto Seguro, Brazil and Surinam to English Harbour, Antigua (Fisher) and the Tortugas, Florida (Sluiter, Clark). Apparently a shallow water form.

Phyllophorus parvus (Ludwig)

Thyonidium parvum Ludwig, 1881, p. 54, pl. 3, figs. 16–18. Théel, 1886, p. 147. Deichmann, 1826, p. 26.

Translation of Ludwig's description: "The unique specimen is 28 mm. long, more tapering toward the posterior end than toward the anterior; 8 mm. in diameter, measured across the middle of the body. The feet are scattered over the entire surface, being still more numerous in the radii where they form distinct double rows. Color pale reddish; 18 tentacles, 9 pairs alternating with 9 smaller. The calcareous deposits are closely packed in the entire outer layer of the integument, being all of the same type; they consist of an oblong disk, which most commonly is perforated by 8 larger and 2 smaller holes, and near the middle 2 rods vertical to the disk and united by a bridge parallel with the disk and ending in about 8 short spines. The calcareous deposits have a length of 0.098 mm. Quite similar deposits are also placed in the feet, but never reaching the large end plate which is composed of 5 pieces.

The calcareous ring consists of 10 narrow, slender calcareous pieces, among which the radials 3 mm. long proceed backwards into 2 prolongations 1.5 mm. long, composed of smaller fragments. Two Polian vesicles, 3.5 mm. long are attached to the water vascular ring; a quite short stone canal, only 2 mm. long with rounded head, is embedded in the dorsal mesentery; the point of attachment for the genital organs, several times divided, placed on each side of the dorsal mesentery, is 10 mm. behind the oral end, with tentacle crown withdrawn; the insertion for the strong retractors is 9 mm. behind the oral end; the cloaca is 6 mm. long."

Type locality.— Coast of Brazil.

A single specimen was subsequently collected, at low water mark, in English Harbour, Antigua (Fisher). University of Iowa.

Echinocucumis Sars 1859

Diagnosis.— Tentacles 10, unequal in size; 2 lateral being much larger than the 4 dorsal, which in their turn are slightly larger than the 4 ventral. Body spherical with mouth and anus placed at end of tubes which seem to be nonretractile. Few pedicels, arranged on the ambulacra, slender, thread-like. Body covered with very large scales, perforated by large regular holes, which become smaller toward the edge; these scales are never built up of several layers of reticulated network; but most of them are provided with a slender spire, usually placed near the margin; along the ambulacra some of the scales are provided with an incision for the passage of a pedicel.

Type.— *E. hispida* (Barrett).

Only one species is known with certainty. (*E. adversaria* Semper, 1868, incompletely known, seems to be a typical *Cucumaria*, related to the *calcigera* group, as far as I have been able to determine from the description and figure given by Semper.)

Echinocucumis hispida (Barrett)

Plate 18, fig. 9

Eupyrgus n. sp. Lütken, 1857, p. 24, 69.

Eupyrgus hispidus Barrett, 1856, p. 7, 46, pl. 4, figs. 1a–6.

Echinocucumis typica Sars, 1861, p. 102–110, pl. 10, figs. 11–20; p. 11, figs. 1–17. Pourtalès, 1869, pl. 151. Théel, 1886, p. 118, 119; 1886a, p. 9, 10, fig. 3. For other references see Ludwig, 1901, p. 232, under *Cucumaria typica* and Mortensen, 1924, p. 232.

Not *E. typica* Clark, 1923, p. 418.

A small form only few cm. in length; body spherical, tapering into

short anterior and posterior tubes, which, in the Norwegian form at least, seem unable to contract. Tentacles 10, simple, finger-shaped, the 4 dorsal and the 4 ventral very small, the remaining 2, one on each side, much longer. Feet few, very thin and slender, and present only on the ambulacra, absent near oral and anal ends and in the dorsal ambulacra.

Internal anatomy not peculiar. A low simple calcareous ring of 10 equally large pieces; one Polian vesicle, one small stone canal, dorsally attached. Distinct muscle stomach; very long and coiled intestine; course as usual, the third loop running in the left ventral interambulacrum; cloaca large. Respiratory trees quite abortive, with 1–2 small lobes. Musculature thin; retractors are attached a little anterior to the middle of the body cavity. Genital organs in 2 large tufts, with thick tubes, attached at almost the same level as the retractors.

Deposits.— Large circular plates more than 1 cm. in diameter in the full grown specimen, composed of a single layer of calcareous material, perforated by numerous large holes, which become smaller toward the margin; most plates are provided with an eccentric spire, composed of several pillars united with irregularly placed cross beams and with spines scattered over the sides. The scales along the ambulacra lack the spire in many cases and present often an incision for the passage of a pedicel. These have no end plate and contain only some small curved supporting rods, often with a knob-like vestige of a spire on the middle. The introvert contains tables and plates; the tentacles are crowded with perforated rods and plates, often with three arms and a few large holes.

Type locality.— Coast of Norway (Barrett).

Type probably not existing.

Quite common in the northeastern part of the Atlantic Ocean, ranging from North Cape to Bay of Biscay. In all cases where I have been able to go over the record of the depth it has been taken at 100–250 fathoms.

The description given here refers to material from Scandinavia. The material from the coast of America is too scanty to allow a more detailed examination.

A species which by its spicules belongs to the typical form, occurs near Florida, recorded by Pourtalès. Also from "Albatross" stations 2,644, 2,646.

Remarks.— Théel notes that specimens from the West Indian region are somewhat different from the typical form, and upon reëxamination

some of them have proved to be apparently young specimens of *Sph. asperrima,* whereas others differ so much that they may be regarded as a distinct form as follows.

Echinocucumis hispida (Barrett) forma atypica

Plate **18**, figs. 10, 11

Differs from the typical form by its often larger scales, sometimes with centrally placed spine which is longer and more slender than usual, and composed of one solid rod, with a few spines scattered along the sides. Only known from off St. Kitts, 116 fathoms depth, and off Havana, 100 fathoms depth.

Type in Museum of Comparative Zoölogy.

Sphaerothuria Ludwig 1894

Syn. *Ypsilothuria* Perrier, 1901

Diagnosis.— Eight to ten tentacles, finger-shaped, of different lengths, 1–2 on each side considerably longer than the remaining. Body spherical, with mouth and anus placed on long tubes, which may or may not be retractile, perhaps according to the age of the animal. Skin covered with very large scales, composed of reticulated network, at least in old specimens, and with a long spire built of several rods and covered with spines. Feet few, slender, confined to the ambulacra and almost absent dorsally; near the ends the feet pass through a small hole in the scale, often quite close to the spine. Other features as in *Echinocucumis.*

Type.— *Sphaerothuria bitentaculata* Ludwig.

Key to the West Atlantic species

Scales with coarse, reticulated network, which is developed relatively late; two long tentacles on each side; tentacles filled with plates, perforated by numerous small holes . . . . *S. asperrima* (Théel)

Scales with finely reticulated network, developed relatively early; one long tentacle on each side; tentacles with strongly curved cylindrical rods with few spines and perforated ends . . . . *S. talismani* (Perrier)

Sphaerothuria asperrima (Théel)

Plate **19**, figs. 1, 2

Echinocucumis asperrima Théel, 1886a, p. 10.

Echinocucumis typica Théel (partim), 1886, p. 118.

The type specimens are very large, the diameter of the spherical body, without oral and anal tubes, being about 2 cm., the tubes together measuring about 2 cm. They seem in these large specimens quite unable to retract; in some smaller specimens, which I with some doubt refer to this form, the oral and anal tubes which are very close together are completely retracted. The introvert with the tentacles is withdrawn, but a dissected specimen had two large tentacles on each side and apparently 4 small dorsal and 2 small ventral; the introvert had been cut out of the animal, so maybe it was 2 small dorsal and 4 small ventral. The scales are very large, more than 2 mm. in diameter; the feet are few, apparently present only in the ventral ambulacra, and they pass through the scales near the spine. They are often difficult to find. Color whitish, some specimens covered with a brownish stuff, most likely of foreign origin.

Internal anatomy almost like that of *Echinocucumis hispida*. A simple calcareous ring, distinctly composed of 10 pieces, with low anterior teeth and undulated posterior margin; one Polian vesicle and one small dorsal stone canal; muscle stomach short; intestine extremely long with large coils; the exact course of the mesentery could not be determined; two laterally placed respiratory trees with well-developed lateral branches. Musculature thin; the circular layer forming a thin film, the longitudinal bands thread-like; the retractors attached near the bases of the oral tube. Genital organs few, divided once near base, less than 1 cm. in length. They contained ripe eggs in the specimens examined, and were attached near the oral tube.

The deposits in the large type specimens consist of very large scales with numerous, relatively small holes in the thick primary disk and coarse reticulated network; the spire is strong, composed of several pillars and provided with spines; it is often almost centrally placed. Toward the terminal ends the scales become smaller. The feet seem to lack deposits; the introvert contains numerous scales with simple pointed spire. The tentacles are filled with curved plates with numerous holes and undulated edge.

In some of the smaller specimens, which Théel has labeled as *Echinocucumis typica* var. *globosa* (the name of the variety has never been published), I have found that in most cases only one layer, the primary disk of the scale, is present and the animals would therefore naturally be listed as belonging to *Echinocucumis*, but the fact that the feet penetrate the scales and that the size of the holes of the scales agree in size with those found in typical *S. asperrima* has convinced me that these specimens are identical with that species.

Type locality for Théel's large specimen.— Off Isle of Pines, Cuba, 158 fms.; also known from off Kingston, Jamaica, 150 fms.; off Fredrikstadt, Virgin Islands, 180 fms.

The small specimens, listed as *Ech. typica* (var. *globosa*), are from the following localities: off Morro Light, Havana, 240–400 fms.; off St. Lucie, Florida, 116 fms.; off Barbados, 209 fms.

All are in the Museum of Comparative Zoölogy.

Sphaerothuria talismani (Perrier)

Plate **19**, fig. 3

Ypsilothuria talismani Perrier.
Echinocucumis typica Clark, 1923, p. 418.

The specimens examined are all small, about 1 cm. in total length, and seem to agree with *Sph. asperrima*, except that there is only one large tentacle on each side of the oral opening, and the scales are even at this stage built up of reticulated network, which is much finer than in the preceding species. The tentacles are filled with quite different spicules, they are strongly curved, simple rods, cylindrical with a few spines, the ends being flattened and perforated by a few holes.

The specimens in the Museum of Comparative Zoölogy, which were designated as *E. typica* by Théel and *Sph. bitentaculata* by H. L. Clark, are from the following localities: north of Havana, 339 fms.; off St. Vincent, 464 fms.; off Grenada, 567 fms. In the United States National Museum one specimen is present from "Albatross" station 2,096.

Distribution.— Cape of Good Hope; west coast of Africa and Europe (coast of France), Caribbean Sea.

Remarks.— The specimens examined seem to be identical with the greater part of Perrier's *Sph. talismani*, perhaps also his *attenuata;* his descriptions are very short. It may be that some of his specimens are identical with *Sph. asperrima*, and one of his figures resembles very much a specimen of *Ech. typica*. I think that his specimen from the Bay of Biscay, from 600 m., is identical with that species.

This species is very closely related to Ludwig's *Sph. bitentaculata* but differs, first by its possession of 10 tentacles, a very slight distinguishing character, as it may be that the two ventral tentacles are occasionally completely aborted, or have been overlooked, and second, by the slightly different form of the supporting rods in the tentacles, which in Ludwig's form are flat rods or narrow perforated plates (pl. 19, figs. 4, 5), whereas in Perrier's species, as here interpreted (Perrier gives no figures of the spicules), the rods are cylindrical, with flattened ends.

CUCUMARIA Blainville 1834

Diagnosis.— Dendrochirote Holothurians with 10 tentacles of equal size, or the 2 ventral ones smaller. Ambulacral appendages chiefly in rows along the ambulacra, absent or more sparingly distributed in the interambulacra, and in that case mostly in the dorsal ones. Spicules of various kinds, sometimes almost lacking.

No type species is given as the group is entirely heterogeneous and several species at present included belong in *Thyone*. The group will undoubtedly be divided in the future into several genera.

Key to the species of Cucumaria known from the western part of the Atlantic Ocean

1. Tables among deposits 2
1. No tables among the deposits 3
2. Tables large, of very variable size and shape; a densely crowded layer of plates beneath the layer of tables. The calcareous ring has long posterior prolongations. Up to 10 cm. long. Arctic . . . . *C. calcigera* (Stimpson)
2. Tables oval with four holes, occasionally some have more; spire two pillared and often reduced. About 5 cm. in length. Tropical form which may reach the coast of New England . . . . *C. pulcherrima* (Ayres)
3. Plates and baskets 4
3. Plates alone 5
4. Irregularly perforated plates, generally of oblong shape and with a few flattened baskets with spines on the margin. Plates in the pedicels. Radials very high with small posterior prolongations; interradials short and triangular, the feet tend to become placed in single rows toward the ends. Only known specimen 1.3 cm. long. Tropical form . . . . . . *C. vicaria* Sluiter
4. Irregular plates with larger and smaller holes; a few, flattened baskets, almost without spines on the margin. Very few supporting rods, mostly in dorsal appendages. Simple calcareous ring. Few cm. long. Coast of New England . . . . *C. nina* nov. sp.
5. Plates regularly four-holed, with well developed knobs. Elongate tables in feet. Prolongations on the ring almost as long as the radials are high. Feet ambulacral alone. Small tropical form . . . . *C. argillacea* Sluiter
5. Plates irregular with smooth to undulated surface; if knobs are present, they are few and scattered 6
6. Plates few except in very young specimens, and reduced during growth. Feet large, soft, completely retractile, scattered in dorsal interambulacra. Up to 50 cm. long. Arctic, subarctic form . . . . . . *C. frondosa* (Gunnerus)
6. Feet confined to ambulacra, not soft, not completely retractile. Deposits numerous. Small form, few cm. in length. From coast of New England. *C. parassimilis*, nov. sp.

Cucumaria calcigera (Stimpson)

Plate **11**, figs. 9–12

Pentamera calcigera Stimpson, 1851, p. 67. Verrill, 1866, p. 352.
C. korenii Lütken, p. 4–7, 104.
C. kalcigera, Duncan and Sladen, 1881, p. 5–8, pl. 1, figs. 3–8. Norman, p. 206, 207. Ludwig, 1873, p. 277, p. 6, figs. 1–5. Clark, 1901c, p. 492. Mortensen, 1910, p. 290.

Maximum length of specimens from the coast of New England about 9 cm. Club-shaped, the anterior end more blunt than the tapering anal end. Often the animal is so strongly curved that the two ends almost meet. Oral end usually retracted, with 10 much branched tentacles, the 2 ventral being much smaller. Pedicel nonretractile, in 5 distinct bands, most numerous at the middle of the animal, where they are crowded into 4 or 5 rows; towards the ends they are more scattered and form zigzag rows. Color white, with dark introvert and tentacles.

Internal anatomy.— A very high calcareous ring with long tails on the deeply cleft radials; often the ring is composed of small pieces. Radials also high and very narrow. One Polian vesicle and one stone canal with flattened head. Short muscular stomach and intestine with the usual course, first along the dorsal midline, then in an oblique line across the left dorsal and ventral muscle bands and after having made a loop into the right ventral interambulacrum, it runs backward along the left side of the midventral muscle band. Cloaca long, as is usually the case in the forms with long tail-like end. The respiratory trees are well developed, with very large accessory branches, giving the impression that there are 4 trees in all. The musculature is strong. The retractors are set about one third the body length behind the oral end, when measured in the ventral midline, but they are placed anterior to the attachment of the mesentery of the intestine.

The genital organs are present as numerous, long tubules, which are attached to the body wall in the same region as are the retractors.

Deposits, numerous tables and plates; outermost a layer of irregular tables, with rounded to stellate disk, often with 4 arms; as a rule 4 large central holes are found, among which 2 again are larger, and outside these a variable number of smaller holes. The spire is usually composed of 2 rods, although 3 or 4 may occasionally be present; it ends in a variable number of teeth, arranged at different heights; 2 cross beams are often present.

The plates form a closely packed layer beneath the tables and are,

as a rule, elongate; in the simplest cases they have 4 central holes and 1 or 2 holes in the ends, but usually they have developed 2 rows of holes, or they may be rounded or even star-shaped.

In the feet we find a well-developed end plate, with a circle of larger radially placed holes, arranged around the central portion of smaller holes. In the sides of the feet numerous elongate tables are found, usually high, well-developed spire, composed of 2 rods. In the tentacles numerous, often symmetrically developed, perforated rods of almost equal size through the entire tentacle.

Type locality.— Coast of New England, thrown up on the coast after a storm; type not existing. Dredged from several localities off the coast of New England, and occurring also along the coast of Labrador. Known also from Barrow Strait and Wellington Channel. It is very abundant along the west coast of Greenland, but is not known east of Cape Farewell (except, perhaps, at Nova Zembla). A very closely related form, if distinct, occurs in Bering Sea, and it is probably this form which has been recorded from the west coast of Waigatsch, Nova Zembla (according to Ludwig). All the records of *calcigera* from south of Bering Sea, in the Pacific Ocean, are undoubtedly wrong (excepting possibly the records from a few localities in Alaska).

From the coast of New England it has been dredged only from a depth of 20–40 fms.

It is possible that the Pacific form of *C. calcigera* is identical with Brandt's *albida*, which was collected at Sitka.

Cucumaria pulcherrima (Ayres)

Plate **11**, figs. 13–16

Pentamera pulcherrima Ayres, 1854, p. 20. Verrill, 1873, p. 715. Théel, 1886, p. 139.

Thyone pulcherrima Semper, 1868, p. 66. Théel, 1886, p. 139.

Cucumaria pulcherrima Clark, 1902, p. 567, pl. 11, figs. 70, 81–85. Coe, 1912, p. 113.

C. quinquesemita Selenka, partim, 1867, p. 351.

Length of largest specimen measured about 5 cm. in contracted condition. Body form seems invariably to be short, almost ovoid. with the anterior and posterior portion dorsally directed. Five crowded rows of cylindrical, nonretractile pedicels, strictly confined to the ambulacra. Ten very bushy tentacles, the 2 ventral smaller. Skin thin, often transversely wrinkled and stiff, because of its great content of calca-

reous deposits. Color white or dirty brown, probably in relation to the kind of bottom upon which the animal lives. The tentacles are dotted with a dark brown pigment.

Internally a high, typically formed calcareous ring with long posterior prolongations deeply cleft on the radials; the interradials are high and narrow, only slightly incised posteriorly; often the ring appears to be composed of a mosaic of small pieces. One Polian vesicle and one long stone canal, embedded in the dorsal mesentery and with the head free. A short muscle stomach and a very long intestine with the usual course. Respiratory organs unusually large and richly branched, some of the branches near the cloaca almost form independent trees. The longitudinal, as well as the musculature, is well developed; the retractors split off at about one third of the body length from the oral end. The genital organs form two clusters with numerous long unbranched tubules, fastened near the retractors' origin. The ampullae of the feet are visible internally as clear elliptical vesicles which are arranged along the sides of the longitudinal muscles.

Deposits.— A crowded layer of regular, oval tables with 4 holes and a low spire, composed of 2 rods and ending with 2–3 blunt teeth; often the spire is reduced. A few thin, elongate plates with 2 central holes, and a variable number of smaller holes near the ends may occasionally be found. A great number of irregular plates are crowded around anus. In the feet a well-developed end plate is present, and numerous elongate tables with more or less reduced spire. In the tentacles, irregular, perforated plates. Apparently no deposits in the introvert.

Type locality.— Charleston. Type not existing. This form is undoubtedly a tropical form which occasionally reaches the coast of New England. It has been recorded from Sabanilla, Colombia (United States National Museum, Washington) and from Beaufort, N. C., where it quite often is found in shallow water, buried in mud (Grave). Very inconstant in its occurrence on the coast of New England, where it apparently lives in deeper water and only is washed ashore after heavy storms; sometimes it is taken by dredge, but it is often abundant one year and not the following.

It is one of the few forms which has been reared from the egg (Grave) to adult, but unfortunately no adequate account of the development has ever been published.

Cucumaria vicaria Sluiter

C. vicaria Sluiter, 1910, p. 3, text-fig. C.

The following is translated from Sluiter: " 13 mm. long and 4 mm. wide, tapering backwards more than forwards; near the middle the animal is pronouncedly five-edged, but not markedly so towards the ends. The anus lacks teeth, but is distinctly five-edged. The feet are arranged in double rows only near the middle of the body; towards the ends they are placed in single rows. There are 10 tentacles of equal length. The integument is rather thick, but firm and rigid, due to the numerous calcareous deposits, yet it is not quite stiff. The deposits are plates of irregular form, usually oblong. Beside these we find a few baskets with spinous rim; in the pedicels there are plates, not rods.

Calcareous ring.— "Radials high, with short posterior prolongations; interradials small, blunt, triangular; they only extend backward for a short distance, but in front they are at the same level as the radials. A rather large Polian vesicle is attached to the vascular ring, as well as a single stone canal.

"This west-Atlantic form is at least closely related to *C. pentactes* Linn. from the coast of Europe, but it differs in the form of the calcareous ring and the somewhat aberrant shape of the calcareous bodies."

Type locality.— Barbados.

Type in Museum of Berlin. Only known from the type locality.

Cucumaria nina sp. nov.

Plate **12**, figs. 1–5

Length of mature specimens about 1 cm.; body shaped like a lemon, with mouth and anus slightly elevated. Ventrally 3 rows of large, soft pedicels arranged in single series, 7–9 in each; dorsally we find double rows, also scattered pedicels in the dorsal interambulacra; these are much smaller than the ventral pedicels, and only visible as points. The tentacles are much branched and crowded with spicules; the two ventral ones are much smaller. The skin is thin and filled with spicules. Color whitish.

Internally we find a simple calcareous ring, the radial and interradial pieces are of almost uniform size, except that the radial pieces project a little more forwards than the interradial pieces. A single Polian vesicle, and a long stone canal with divided head, attached in the mesentery. Muscle-stomach short, well developed; intestine relatively

short. Respiratory trees short and feeble, with very small and few branches. The musculature is delicate; the retractors split off in the first third of the body length. The genital organs, which seem to be ripe, are attached at about the same distance from the oral end; they are remarkably short and thick, fingerlike and few in number.

Deposits.— Numerous large, thin plates, generally oblong in shape and perforated by several holes which become smaller toward one or both ends. A few, easily overlooked, very flat baskets are also present. No end plate in the ventral feet, which seem to lack all deposits; in the dorsal appendages we find a rudiment of end plate and a few elongated, supporting rods. Numerous perforated rods and plates in the tentacles.

The relationships of this small form are not easily determined. At present it occupies a quite isolated position.

Type locality.— East of Georges Bank, depth 101 fathoms. Collected in September, 1883.

Type in United States National Museum, Washington, cat. no. 18,222.

At present only known from off the coast of New England, from relatively deep water.

CUCUMARIA ARGILLACEA Sluiter

C. argillacea Sluiter, 1910, p. 336, text-fig. Ba-c.

The single specimen is 8 mm. long, pale gray and decidedly five-edged, only slightly tapering toward the ends and without anal teeth. Integument fragile and crisp, on account of the great amount of calcareous deposits. These are found in the shape of rather regular plates with 4 holes and 4–6 knobs, also as plates with a greater number of holes and knobs. We also find smooth plates with several holes.

In the wall of the pedicels are the usual kind of tables, with rod-shaped elongate disk. The calcareous ring consists of 10 pieces, the radials with long posterior prolongations which are nearly as long as the rest of the ring is high; the interradials are almost triangular and as high as the undivided part of the radials. One Polian vesicle and a single stone canal. The genital organs are only feebly developed, short and undivided.

Type locality.— Tortugas, Southwest Channel; depth 12 fms.

Type in Museum of Berlin.

The species has not been recorded since. It is impossible to say whether so young a specimen belongs to the genus *Cucumaria* or to *Thyone*, and hence it is useless to attempt to discuss its relationships.

Cucumaria frondosa (Gunnerus)

Plate 12, figs. 6–9

Holothuria frondosa Gunnerus, 1770, p. 121–125, pl. 4, figs. 1, 2.
Holothuria pentactes O. F. Muller, 1788, p. 36, pl. 31, fig. 8.
Botryodactyla grandis Ayres, 1851, p. 52.
Botryodactyla affinis Ayres, 1851, p. 145.
Cucumaria fusicola Forbes, 1841, p. 227.
Cucumaria frondosa Ludwig, 1901, p. 150 (with complete bibliography. All records from the Pacific Coast refer to closely related species). Clark, 1904, p. 564. Edwards, 1910, p. 333, pl. 13. (The literature since 1910 has not been given, as none of the papers deal with the occurrence of the species on the coast of North America.) Not *C. frondosa* Pourtalès, 1869, p. 359, 361 (from off Florida).

Maximum length about 50 cm. A soft-skinned form, usually barrel-shaped, with ten bushy tentacles of equal size, and soft, completely retractile large feet, which are arranged in rows along the interambulacra, and also occur more or less reduced in development in the dorsal interambulacra. Mouth and anus terminal. Skin soft, leathery. Color brown in preserved condition, paler in young specimens; occasionally pure white or yellowish specimens may be found.

Internally a very loosely united calcareous ring of simple form; the calcareous mass is reduced more or less with advancing age. One very long Polian vesicle, sometimes as long as the contracted animal itself. The stone canal is attached in the dorsal mesentery and has a large round head. A long and slender muscle stomach and a very long intestine with the usual course, first in the dorsal interambulacrum, then forwards across the left dorsal and ventral muscle bands, reaching so far forwards that the mesentery is perforated for the passage of the retractors, and finally the intestine runs along the left side of mid-ventral muscle band.

Respiratory trees large and very bushy, attached in the lateral interambulacra and partly also to the lateral ventral muscle band. The musculature is strong and fleshy, the retractors are attached near the middle of the body wall. The genital organs are, when well developed, very long and numerous tubules, attached near the middle of the body wall and almost entirely hiding the other organs.

The spicules are well developed only in very small specimens, a few cm. long. They consist of roundish plates, regularly perforated, and with a few knobs scattered here and there. Also more button-like plates with 4 holes are occasionally present. In the feet we find a

small vestige of an end plate and some elongate plates or rods. In the tentacles a few, long, perforated plates may be found.

This Arctic and subarctic form ranges from the coast of northern Europe (Scandinavia and Great Britain) to the Faeroes and South Iceland, coast of Greenland and down to the coast of New England. The record of its occurrence off Florida is due to a mistake, as Pourtalès' specimen is not *frondosa* but a species closely related to *Colochirus violaceus* Théel (see p. 182).

It is also due to errors in identification that it is recorded from the Pacific Ocean, where 3 closely related, but distinct species are found. It seems to be most closely related to *C. fallax* Ludwig which occurs in Bering Sea, but the latter species retains its somewhat differently formed spicules for a longer period.

The type locality is off the coast of Scandinavia but the type does not exist.

It usually occurs just below tide mark, but is also taken in deeper water (200 fms., according to Ludwig). It seems to prefer rocky shores where it clings to the rocks, usually without making any attempt to hide itself, and is often found in great numbers.

It has a free-swimming larva, the development of which has been studied by Runnström (1917–18).

Cucumaria parassimilis sp. nov.

Plate **13**, figs. 1, 2

Maximum length of apparently mature specimens, a little more than 1 cm. Form cylindrical, with 5 rows of feet which dorsally show some tendency to spread into the interambulacra; the feet are not crowded and are apparently nonretractile. Tentacles 10, the 2 ventral smaller; they are stiff, completely crowded with deposits; introvert very short. The skin is thin, crisp, filled with deposits. Color pale brownish.

Internally a low simple calcareous ring; other features quite normally developed; the retractors and genital organs being placed a little anterior to the middle of the body cavity; the genital organs consist of a few tubules, which in one specimen contained a few eggs.

Deposits.— Perforated plates of variable size, roundish or elongate, with few to many holes; surface with small knobs; in pedicels rods and plates, but apparently no end plate; in tentacles similar plates and rods; no special kind of deposits in the short introvert.

Type locality.— Georges Bank, "Albatross" station 2,523; also re-

corded from middle ground, Halifax; off Cape Cod and east of Georges Bank. Depth 80–121 fms.

Remarks.— This species may be identical with *C. assimilis* Danielsen and Koren from Norway; the authors compared their specimen with small *C. frondosa*, but the species has never been recorded since, and *C. assimilis* is usually listed as a synonym of *C. frondosa* (among others by Dr. Th. Mortensen, 1924).

The new species has been compared with typical small *frondosa;* their outer aspect is entirely different, *frondosa* being a soft-skinned animal with few large, soft and retractile feet, even when only 1 cm. long, whereas *C. parassimilis* is stiff, with tapering, nonretractile feet; the ventral feet are also distinctly smaller than the other in *C. parassimilis,* whereas they are all of the same size in *C. frondosa;* the spicules are also different, being usually more elongate in *C. parassimilis.*

Thyone Oken 1815

Diagnosis.— Dendrochirote Holothurians with 10 tentacles of equal size or the 2 ventral ones smaller. Ambulacral appendages even in young specimens numerous, also in the interambulacra, and usually most abundant ventrally. Arrangement in bands along the ambulacra more or less indistinct. Deposits of various kind, often reduced.

No type species is given as the group is quite heterogeneous, some species hitherto referred to this group belong undoubtedly to the genus *Cucumaria.* The group will in the future be divided into several genera.

Key to the species of the genus Thyone, at present known from the West Indian Seas and off New England

1. Deposits in body wall as tables (*Thyone sensu strictu*) 2
1. Deposits in body wall chiefly as knobbed buttons or plates 5
2. Spire composed of 4 rods, disk irregular with 7–8 holes. Calcareous ring very high but with relatively short posterior prolongations. *Thyone briareus* (Lesueur)
2. Spire composed of 2 rods 3
3. Disk irregular with numerous holes; tables large and very solid; in introvert more delicate tables and no rosettes. Solid rods in tentacles. Curved, tapering body form . . . . *Thyone scabra* Verrill
3. Disk regular, oblong, usually with 4 holes (sometimes 4 outer accessory holes). In the introvert often tables and always rosettes; delicate rods in tentacles 5

4. Disk thin with 4 large holes, often 4 accessory ones; spire high, with delicate pillars, tapering, ending in few small teeth . . *Thyone fusus* (O. F. Müller)
4. Disk thick, with 4 small holes, no accessory holes; spire low with thick pillars and ending in numerous robust teeth. (In some cases the tables develop a handle on the other side of the disk.)
Thyone pseudofusus nov. sp.
5. Supporting rods as tables with distinct spire; posterior prolongations on radials; rosettes in introvert and tentacles; sometimes also tables in the introvert. Scattered irregular large plates 6
5. Supporting rods never as tables. Calcareous ring usually single, only occasionally with very short posterior prolongations. Strong rods in tentacles; in some cases rosettes in introvert 7
6. Buttons with thick smooth handle, strongly knobbed and short. Tables and rosettes in introvert; in tentacles rosette-like plates.
Thyone belli Ludwig
6. Buttons usually without handle, regularly knobbed and with a tendency to become elongate, especially in young specimens; a few of the small buttons may have a thin handle with small spines on the top, thus resembling a table. Large complicated rosette-like plates in introvert and tentacles; no tables in the former . . . . *Thyone micropunctata* Sluiter
7. Deposits elongate, perforated plates, almost smooth.
Thyone cognita (Lampert)
7. Deposits mostly 4 holed knobbed buttons, regular or irregular 8
8. Among deposits no outer layer of baskets. Midventral series of feet usually distinctly separated from the remaining appendages which are uniformly distributed . . . . *Thyone unisemita* (Stimpson)
8. Among deposits an outer layer of baskets 9
9. Baskets deep with a narrow opening fringed with numerous irregular small teeth both on the inner and the outer side. Buttons strongly knobbed, very regular and of very different sizes . . . . *Thyone solida* nov. sp.
9. Baskets relatively flattened, widely open, either with few large distinct teeth or with some very blunt and indistinct ones 10
10. Feet cylindrical all over the body, with distinct end plate, simple or composed of smaller plates. Tentacles of equal size 11
10. Feet papilliform toward the ends; end plate often small or absent in several of the appendages. Ventral tentacles smaller 12
11. Deposits few, large-holed buttons; few, often incomplete baskets; large holes in the supporting rods; skin soft . . . . *Thyone suspecta* Ludwig
11. Deposits numerous; partly large-holed, regularly knobbed and partly swollen, small-holed; baskets large, well developed; supporting rods with small holes; skin relatively stiff . . . . *Thyone surinamensis* Semper
12. Feet uniformly spread, usually contracted to low warts.
Thyone pervicax Théel
12. Feet in distinct double rows along the ambulacra and also scattered in the interambulacra 13

13. Baskets very small, much smaller than the buttons are wide, and with blunt incomplete teeth. Buttons very irregular; regular smooth perforated plates are also present .... *Thyone sabanillaensis* nov. sp.
13. Baskets large, about as broad as the buttons are wide and with about 8 large conical teeth. Buttons swollen, irregular; smooth regular plates are never found .... *Thyone gemmata* (Pourtalès)

Thyone briareus (Lesueur)

Plate **13**, figs. 5–7

Holothuria briareus Lesueur, 1824, p. 161. Gould, 1841, p. 345.
Sclerodactyla briareus Ayres, 1851–54, p. 101. Pourtalès, 1851, p. 9.
Anaperus carolinus Troschel (partim), 1848, p. 62. Pourtalès.
Thyone briareus Selenka, 1867, p. 353. Coues and Yarrow, 1878, p. 305. Ludwig, 1882, p. 132. Lampert, 1885, p. 168. Théel, 1886, p. 133. Clark, 1901, p. 484; 1901b, p. 567, pl. 11, fig. 67; pl. 13, figs. 96–102; 1919, p. 63. Coe, 1912, p. 116, 133, text-figs. 21, 25, pl. 29, fig. 15; pl. 30, 31.
Thyone tenella Selenka, 1867, p. 354.
Not *Sclerodactyla braziliensis* Verrill, 1868, p. 370.

About 100 specimens examined

Grows to about 10–12 cm. in length; specimens less than 5 cm. long seem never to have been collected. It is a barrel-shaped form with numerous tapering appendages, which cover the animal like a coat of hair. Tentacles large, bushy, the 2 ventral smaller. Anus surrounded by a complete calcareous ring. Color variable, usually brownish or greenish. Skin soft with few deposits, which become scarce with advancing age. Internally a high, tubelike calcareous ring, the radials as well as the interradials being high, the former with relatively short but distinct posterior prolongations. One Polian vesicle and one stone canal, with large round head, attached to the mesentery. Distinct muscle stomach and a very long intestine, with the usual course. The respiratory trees are of almost equal length and attached in the lateral interambulacra. Musculature remarkably thick, fleshy and projecting into the body cavity almost as septa. The genital organs are present as very long and slender tubules attached in 2 bundles near the middle of the dorsal side, absent only in specimens a few cm. long.

The deposits are few, in some specimens almost absent. They consist of tables usually with 4 large ventral holes and 4 outer smaller ones and a spire built up of 4 rods — an unusual feature in this group — and ending in a variable number of teeth. The feet are provided with a large end plate and numerous elongate tables with complicated spire,

usually built up of 4 confluent rods, forming a network and ending in a few teeth; the deposits seem to be heavier near the anal end. In the introvert, numerous more delicate tables with more holes in the disk and lower, often incomplete spire, also with 4 rods. In the tentacles, numerous large, perforated rods.

Remarks.— Selenka's *Thyone tenella*, in the collection of the Museum of Comparative Zoölogy, is only a pale, swollen specimen of *T. briareus*, without any deposits.

The specimen which Pourtalès describes as *Anaperus carolinus* Troschel is undoubtedly identical with *Thyone briareus* (calcareous ring very long and strong, also a smaller calcareous ring around anus).

Troschel's *Anaperus carolinus*, which he records from both Peru and South Carolina, is undoubtedly in the first case one of the soft-skinned species of *Thyone* from the Pacific Ocean, in the other simply *Th. briareus*.

This species is, as far as can be determined, identical with *Holothuria briareus* Leseueur; the type locality is St. Bartholemew, West Indies; the type no longer exists.

It is a very common form, ranging from Woods Hole to Texas and has been taken from low tide mark to some fathoms depth, usually on muddy bottom, occasionally on sand. The development is not known, and small specimens are not represented in any of the collections to which I have had access.

Thyone scabra Verrill

Plate **13**, figs. 3, 4

Thyone scabra Verrill, 1873, p. 100. Théel, 1886a, p. 135; 1886b, p. 11. Clark, 1901, p. 568, pl. 11, fig. 71; pl. 13, figs. 91–94; 1901c, p. 494. Coe, 1912, p. 136, pl. 32, fig. 7.

About 20 specimens examined

A relatively small form, usually about 5 cm. in length when measured along the midventral radius; specimens 10 cm. long have been recorded. The body is usually strongly curved with tapering anal end. The tentacles are usually retracted, the 2 ventral are smaller; the feet are uniformly distributed; they are hairlike, tapering, and seem unable to retract. The color is whitish, often with a brownish tinge; the skin is stiff, filled with deposits.

Internal anatomy.— Calcareous ring with very long posterior prolongations; the radials are deeply cleft; the interradials are high and

narrow. The other features are as usual. Very long secondary branches on the respiratory trees.

Deposits.— Irregular tables with 7–10 or more holes and a two-pillared spire ending in some indistinct teeth. In the feet a well-developed end plate and numerous elongated tables with a simple low spire, composed of 2 rods. In the introvert we find tables with larger, more circular and more delicate disk; spire low; the tentacles with numerous strong, perforated rods. No rosettes have been discovered.

Distribution.— Coast of New England down to Delaware; ranges from 10 to several hundred fathoms depth (according to Clark, 1901c).

Nothing is known about its habits.

Thyone fusus (O. F. Müller)?

Plate **14**, figs. 1–5

For literature concerning the typical form, see Ludwig, 1901, p. 150–152.

About its supposed occurrence in American waters, Verrill, 1875, p. 14, writes *T. fusus* Danielssen and Koren?, but later in the same paper he writes *T. scabra* (*T. fusus?* not of Koren). Théel, 1886, p. 135, writes *T. fusus?* Verrill, as synonym of *T. scabra*.

Clark, 1921, p. 63, mentions *T. fusus* (O. F. Müller) from Tobago, West Indies, but says: "It is quite improbable that they are really identical with the European '*fusus*.'"

The 4 small specimens collected at Tobago have been examined and it is impossible at present to find any character that distinguishes them from the Norwegian form, except that the radials are very deeply cleft, whereas in the typical *fusus* they are only cleft to the posterior edge of the interradials; the ring of the West Indian form resembles very much that of *Cucumaria aurantiaca* Costa from the Mediterranean Sea, but the latter has no supporting rods in the pedicels; apparently only large specimens of *C. aurantiaca* have been examined, and it may be that larger specimens of the West Indian form will prove to be identical with the Mediterranean species.

It is, therefore, only provisionally that the West Indian form has been listed under the name *Thyone fusus*.

The specimens examined are a few cm. long, of typical *Thyone* aspect, with numerous feet, indistinct in double rows along the ambulacra and also distributed over the interambulacra; 10 tentacles, the two ventral smaller. The feet are fine and tapering, hair-like as in all typical *Thyone*. Color dirty grayish brown, somewhat paler in an expanded specimen.

Internally a high tube-like calcareous ring with long posterior prolongations on the radials; these are cleft almost to the middle of the interradials; Polian vesicle large, single; one small stone canal with rounded head, attached in the mesentery; muscle stomach short; intestine running in dorsal interambulacra, making a long coil at the end of the loop and proceeding forward until it reaches the left ventral retractor, then forming an arch across the left interambulacrum and running backward along the midventral muscle band. Respiratory trees much branched and only attached by a few threads to the lateral interambulacra; retractors attached slightly forward of the middle of the body cavity. Genital organs quite well developed in the expanded specimen, which is 2 cm. long; they were relatively short and apparently undivided and attached near the middle of the body cavity.

Deposits.— Exactly like those found in the European form, with the same limits of variation in regard to size; only four-holed oval tables with tapering spire composed of 2 rods, with few teeth on the top; sometimes the disk has 4 outer marginal holes; these 8-holed tables seem to occur near the ambulacra; in the feet a small end plate, easily overlooked, and numerous elongated tables with well-developed spire. In the introvert and tentacles no other deposits than rosettes, most of them very complicated; in the smallest specimens they are present in all parts of the tentacles except in the finest terminal lobes

Type locality.— Faeroes. Type not existing.

Ranging from Lofoten to the Mediterranean Sea, but not recorded from any of the West African islands.

In the western Atlantic only known from Tobago, British West Indies. Museum of Comparative Zoölogy, cat. no. 1,167.

Thyone pseudofusus sp. nov.

Plate **14**, figs. 6–9

About 25 specimens examined

The largest specimen is about 2 cm. in length. A tapering form often with mouth and anus upward bent; pedicels in double rows and also scattered in the interambulacra, most numerous in the ventral interambulacra; a very small specimen, about 0.5 cm. in length, has only ambulacral feet; tentacles 10, the two ventral smaller; 5 small anal papillae were visible. Skin thin, pliable, except in strongly contracted specimens, and containing numerous deposits; color whitish.

Internally a calcareous ring with very long and deeply divided pro-

longations on the radials; other features as in *T. fusus* and the other species of this group.

Deposits.— Tables with unusually thick disk, with 4 small holes and smooth to slightly knobbed margin; sometimes an extra hole in each end of the disk; spire robust, low, with distinct teeth on the top; in some cases a handle may be present on the inner side of the disk; a very peculiar feature, which gives some of the tables a character between tables and buttons. In the pedicels a well-developed end plate and numerous elongated tables with a small spire with 2 rods. In introvert, tables with irregular disk and rosettes; in tentacles, delicate rods with few holes in the ends.

Type locality.— Yucatan, "Albatross" station 2,362 (18 specimens); depth 25 fathoms.

Types in United States National Museum.

Also from Tobago, British West Indies and Florida (Clark), Museum of Comparative Zoölogy, cat. no. 1,168.

Thyone cognita (Lampert)

Plate **15**, figs. 1–4

Semperia cognita Lampert, 1885, p. 67.
Cucumaria cognita Théel, 1886, p. 266.

About 20 specimens examined

Maximum length of strongly curved animals about 12–14 cm. A decidedly tapering form, in most cases with the oral and anal ends bent upwards. Feet short, small, usually not completely contracted, in double rows along the radii, and scattered in the interambulacra near the middle of the body; toward the ends they are transformed into short conical, stiff papillae. Tentacles of equal size, and small compared to the entire length of the animal. Skin filled with spicules but still somewhat flexible, especially in smaller animals, and sandy to the touch. Color varying from almost white to mottled gray, with yellowish feet; tentacles dark grayish brown.

Internally a delicate calcareous ring more or less distinctly composed of smaller pieces, and with well-developed tails; the radials are deeply cleft, and the interradials are high and narrow with concave posterior margin; 1–2 Polian vesicles and one very small stone canal with round head, attached to the mesentery. Long muscle stomach, intestine attached almost in the dorsal midline, this goes across the left dorsal and ventral muscle bands, and finally runs along the left side of the

midventral muscle band. Cloaca large. Respiratory trees in lateral interambulacra. Retractors remarkably short, attached 2–5 cm. from the oral end in the largest specimen. Genital organs, unbranched, as long tubules in tufts on each side of the mesentery, almost at the middle of the body.

Deposits.— Even in the youngest specimens it has been impossible to find any other kind of deposits than perforated plates, which are, for the most part, elongate with 2 rows of holes, and rather thick, with uneven surface; also small button-like plates, usually with 4 holes. In the pedicels a rudimentary end plate, which is fairly well developed in small specimens and a variable number of slightly curved rods with perforations and often a short third arm from the middle of the rod, thus resembling the elongate tables with rod and two-pillared spire which are found in many *Cucumariidae*. In the papillae near the ends we find numerous large plates of very variable form. In the introvert, irregular rosettes; these are also present in the tentacles, where many heavy supporting rods with numerous terminal holes occur, and also in the finest branches very small delicate rods.

Type locality.— Fernando de Noronhas, Cuba.

Type in Museum of Berlin.

Small specimens from Yucatan, United States National Museum, and from Porto Seguro, Brazil, Museum of Comparative Zoölogy; in the latter collection there are a number of large, beautifully preserved specimens from the Tortugas, Florida (H. L. Clark coll.), so it appears as if the species had quite a wide distribution in the West Indian region.

About its habits, Dr. Clark informs me that it is found buried in soft bottom, in eel grass.

Thyone unisemita (Stimpson)

Plate **15**, figs. 5–10

Anaperus unisemita Stimpson, 1851–54, p. 8, 9.
Stereoderma unisemita Ayres, 1854, p. 46, 47. Selenka, 1867, p. 344, pl. 19, figs. 76, 77. Verrill, 1874b, p. 413. Lampert, 1885, p. 165. Théel, 1886a, p. 142.
Thyone unisemita Clark, 1901, p. 494; 1902 (1904), p. 569, pl. 11, 12. Coe, 1912, p. 135, pl. 32, fig. 1, text-fig. 26.

About 10 specimens examined

A small form, which rarely seems to attain a greater size than 5 cm. Both ends are usually dorsally directed, body cylindrical with blunt ends; the 2 ventral tentacles are smaller than the remaining 8; the feet

are numerous; in the midventral radius they form a distinct double row, separated from the rest of the feet by distinct naked stripes; laterally and dorsally the feet are uniformly distributed. The feet are conical with thickened bases, and are often retracted to low warts. The skin is stiff, filled with numerous deposits; the color of preserved specimens is pure white.

Internally a simple, low, calcareous ring with long anterior teeth and posteriorly undulated; one Polian vesicle, one small stone canal embedded in the mesentery. A short muscle stomach and a very long coiled intestine, running in the dorsal interambulacrum, across the left muscle bands without touching the retractors, and finally attached to the left side of the midventral muscle band. The respiratory trees are long with long secondary branches and laterally attached; the muscle bands are well developed, with distinct longitudinal furrow; the retractors are attached near the middle of the body cavity, where also the 1 cm. long genital tubes have their place.

Deposits.— Four-holed buttons of variable size with smooth to knobbed surface, often one part of the deposit is more knobbed than the rest; in the feet no end plate and no deposits in the terminal part which is shaped like a true pedicel, with distinct sucking disk; in the remaining part of the appendages numerous deposits, mostly buttons and a few supporting rods, which are usually short and dichotomously branched; in the introvert oblong rods and plates which in some cases recall rosettes; in the tentacles numerous elongate, perforated rods and plates.

Although this species bears a close resemblance to forms in which baskets normally occur, I have failed to find any, even in very small specimens.

Type locality.— Grand Banks.

Type apparently lost.

Ranges from Grand Banks, Newfoundland, to Narragansett Bay. According to Clark, its bathymetrical range is from 17–22 fathoms.

Thyone micropunctata Sluiter

Plate **14**, figs. 14–18

Thyone micropunctata Sluiter, 1910, p. 338, fig. D, a-c.

Sluiter's description: "Eighteen mm. long, 4 mm. wide, tapering toward both ends, but the body is still much wider than the distinctly pointed terminal end, which is tail like. Around the anus are 5 anal

teeth. In alcohol the animal is gray, the ventral side is much paler than the dorsal which is more densely dotted over with small dots (visible with a hand lens).

"All appendages are pedicels with well-developed end plate; the 2 ventral tentacles are much smaller than the remaining 8.

"The spicules are numerous and the skin is consequently stiff and fragile. The most common form of spicule is a knobbed plate with holes placed in a cross and on the middle two large knobs, which never unite in a bridge as in *Th. sacellus* (from the Pacific Ocean). Around the margin of the deposits we find usually 10 knobs; plates with 5–8 holes may also occur, and scattered X-shaped spicules. In the pedicels we find tables with elongate disk, curved or rod-shaped as they often are in the pedicels of the Dendrochirotae.

"The calcareous ring is composed of the normal 10 pieces, the radials being provided with posterior prolongations, almost as long as the rest of the piece is high.

"Although this West Indian form bears some resemblance to the European form *Th. raphanus* Düben and Koren, it cannot be united with that species, first because the deposits are entirely different, and second because of the arrangement of the pedicels; moreover, the calcareous ring and Polian vesicles differ. It seems to be a *Thyone*."

Type locality.— Tortugas, 12 fathoms depth, 3 specimens.

Type in Museum of Berlin.

I have referred one specimen from off Florida and several small ones from Tobago to this species; they seem to agree in all anatomical details. It must be remembered, however, that the small size of these closely related animals will never allow any very detailed study of anatomical differences. The deposits seem to agree exactly with Sluiter's description and figures.

Thyone solida sp. nov.

Plate **15**, figs. 11–17; Plate **16**, figs. 1, 2

The type specimen is about 6 cm. in length, strongly contracted; body barrel shaped with mouth and anus slightly turned dorsally; oral valves present as in the genus *Pentacta;* tentacles, 8 large, and probably 2 small ones which have been lost by previous examination. Appendages numerous, very uniformly distributed; they are more cylindrical ventrally and more papilliform dorsally, where they are placed on low warts; skin thick, firm and filled with deposits. Color yellowish.

From another locality several small specimens have been collected a little more than one cm. in length, and with more *Pentacta*-like aspect, most of the feet being arranged in rows, and only a few scattered in the interambulacra; the spicules resemble in every detail those of the larger specimen.

Calcareous ring low, without any trace of posterior prolongations; the radials with a broad, deeply cleft anterior tooth; the interradials with a blunt triangular tooth; one Polian vesicle and one very small stone canal. Intestine with distinct muscle stomach; most of the intestine is ejected, so its exact course could not be examined. Respiratory trees in the lateral interambulacra; muscle bands narrow, thin, with a longitudinal furrow; the retractors are attached a little anterior to the middle of the body; genital organs in the type were few cm. in length, unbranched and attached a little behind the retractors.

Deposits.— Strongly knobbed, regular buttons of variable size and an outer layer of baskets; the baskets are deep, with 4 thick spokes and numerous small teeth on the inner as well as the outer side of the brim. In the feet no regular end plate, but a number of branched rods act as an end plate; numerous thick, supporting rods, with small holes and often a short third arm; in the introvert, numerous, complicated rosettes and small buttons; in the tentacles strong, perforated rods.

Type locality.— "Albatross" station 2,369.

Type in United States National Museum, Washington.

Also recorded from "Albatross" station 2,405, 8 small specimens.

Thyone surinamensis Semper

Plate **16**, figs. 5–8

Thyone surinamensis Semper, 1868, p. 65, pl. 15, fig. 15. Lampert, 1885, p. 158. Théel, 1886, p. 133. Deichmann, 1926, p. 25, pl. 3, figs. 1a-e.

Cucumaria punctata Ludwig, 1874, p. 82. Sluiter, 1910, p. 335. Clark, 1919, p. 63.

Semperia punctata Lampert, 1885, p. 152.

The maximum length which this species seems to attain is about 10 cm. The shape of the body in well-extended specimens is cylindrical, tapering toward both ends which are bent slightly upward. The tentacles are of equal size, large and richly branched. In most cases we have the feet distributed in double rows along the ambulacra, with a tendency to spread in rows in the interambulacra; but the feet seem to be more abundant in the ventral interambulacra than in the dorsal and lateral areas. The feet are conical with distinct end plates and, as

a rule, expanded. The skin is thick, flexible, and contains an abundance of calcareous matter, which in contracted specimens may give some firmness to the integument. Around the anus we find 4–5 soft anal papillae, sometimes one or two of them are double, and below each a small scalelike anal tooth. The color is brownish; tentacles dark, feet usually whitish sprinkled with brown, and provided with brown or yellowish sucking disks.

Internally a well-developed calcareous ring with relatively short anterior teeth on both radials and interradials; the posterior margin is undulated; one Polian vesicle placed to the left ventrally; a small stone canal is attached to the mesentery, with the head free to the muscle stomach; intestine of normal course, making a large coil behind the genital organs, then running backwards, then forwards across the 2d left muscle bands, and finally backward along the midventral muscle band, partly attached to the band itself. The long respiratory trees are attached to the lateral interambulacra; the muscle bands are thin, narrow with indistinct longitudinal furrow. The retractors split off a little before the middle of the body cavity, and the genital organs are attached at the same distance from the oral end, perhaps nearer the middle of the body cavity; the tubes are short in a mature female; in a female with most of the eggs apparently spent, they are much longer, and similar conditions were found in the male genital organs.

Deposits.— Regular buttons and baskets, The buttons are of two kinds: a heavier, small-holed type, with large, slightly elevated knobs, and a more delicate type with large holes and small globular knobs, widely separated; the former type predominates; a few completely flat buttons with large holes may be present.

The baskets are large, only slightly smaller than the buttons are long; distinctly hollow, and with a variable number of 12–20 teeth in the margin; exceptionally the teeth may unite and form a secondary network across the cups.

In the feet we find a large end plate composed of 4–5 pieces and a number of almost straight supporting rods with slightly undulated edge and small holes. In introvert a few rudimentary baskets and buttons and rosettes; in stalk of tentacles almost straight rods, of similar type to those of the feet; in the finer branches rosettes.

Type locality.— Surinam (Semper).

From the northern coast of South America to Barbados, St. Thomas, Virgin Islands; abundant at Bermuda. As far as our present knowledge goes, an exclusively eastern form in the West Indian region. Shallow water form, collected under rocks at low tide.

Remarks.— The one difference between *C. punctata* and *C. surinamensis*, which can be inferred from the literature, is the number of Polian vesicles, 5 in *punctata*, 1–2 in *surinamensis*.

Thyone suspecta Ludwig

Plate **16**, figs. 3, 4

Thyone suspecta Ludwig, 1874, p. 16, pl. 6, fig. 19. Lampert, 1885, p. 157. Théel, 1886, p. 133. Sluiter, 1910, p. 333. Clark, 1919, p. 63. Deichmann, 1926, p. 23.
Thyone braziliensis Verrill, 1868, p. 370. Rathbun, 1879, p. 141.

About 20 specimens examined

In size and other external features resembling *Thyone surinamensis*, except that the skin is extremely soft, almost devoid of calcareous deposits, and the color is in all specimens examined more dirty, with a streak of brown along the middle of each ambulacrum. The internal anatomy seems to agree in all essentials with that of *Thyone surinamensis*.

The spicules consist of a very scattered layer of large-holed buttons with 4 holes and small hemispherical knobs on the margin, and a small layer of baskets of the same type as those found in *T. surinamensis* but much smaller and often incomplete, partly flat. In the feet a large end plate composed of several smaller plates and a number of supporting rods with large holes and undulated margin. In the introvert rosettes and in the tentacles a variable number of perforated rods.

Type locality.— Barbados; shallow water form, collected at low water mark.

Type in Würzburg.

Ranges from Brazil and Colombia to Barbados.

The differences in the spicules between this species and *Thyone surinamensis* have been pointed out in my Barbados-Antigua report (1926); it should be added that examination of a large series shows that the rosettes are very variable in size in both species.

Thyone pervicax Théel

Plate **16**, figs. 9–12

Thyone pervicax Théel, 1886, p. 93, pl. 5, fig. 9; pl. 2, fig. 3.

Maximum length about 7 cm. Body slightly curved with blunt oral and anal ends (when tentacles are withdrawn the oral opening is pentagonal). .Tentacles 10, the two ventral ones smaller, all filled with

spicules; numerous tapering appendages, which in young specimens may be completely retracted, only visible as pits; in older specimens the feet are conical, uniformly distributed and often retracted to low warts. Skin stiff, filled with deposits; color whitish with brown spots or entirely pale brown.

Internally a calcareous ring with long anterior teeth and short posterior prolongations, these prolongations being merely indicated in the type specimen. One Polian vesicle and one very small stone canal attached to the dorsal mesentery; muscle stomach short, course of intestine normal; respiratory trees laterally attached; muscle bands feeble; retractors attached about one third body length from the oral end; genital organs placed near middle of body, present as slender tubules.

Deposits.— Four-holed knobbed buttons of different sizes and an outer layer of cups and also a few large mulberry-shaped bodies. In the feet no end plate seems to be present; only supporting rods, thick, tapering, with a few small holes; in retrovert no rosettes but buttons; in tentacles elongate perforated rods.

Type locality.— Bahia.

Type in British Museum.

Ranges from Bahia to Florida and found also in Vineyard Sound. ("Fishhawk," United States National Museum.) (It may be that *Thyone gemmata* Ayres, with posterior prolongations on the calcareous ring, is identical with this species.)

Thyone belli Ludwig

Plate **14**, figs. 10–13

Thyone belli Ludwig, 1887, p. 21, pl. 1, fig. 6.

Length a few cm.; body slightly curved; tentacles 10, the 2 ventral much smaller; pedicels numerous, indistinctly arranged in rows along the ambulacra, able to contract completely; 5 small anal teeth present. Skins stiff, filled with deposits; color dirty, gray, finely sprinkled with dark, sometimes slightly violet.

Calcareous ring high, radials and interradials high and narrow, of almost the same width; the radials have long slender prolongations and are cleft almost to the middle of the interradials, which themselves are but slightly incised behind. One long ventrally placed Polian vesicle, one long stone canal embedded in the mesentery with an unusually large coiled head, very fragile. The muscle stomach is short, the intestine is long, of the usual course; the muscle bands are thin; the

retractors are attached about one third body length from the oral end, where the long and thin, apparently immature genital organs also are fastened; the respiratory trees are attached in the lateral interambulacra.

Calcareous deposits.— Numerous 4-holed regular, knobbed buttons with 8 marginal knobs and central ones, which in most cases are united by a distinct handle. End plate well developed, and numerous oblong supporting tables often with only a rudiment of a spire. In introvert and stalk of tentacles tables and rosettes; in tentacles rosettes and delicate perforated rods.

Ludwig mentions also that a few large perforated plates may be found in preparations of spicules from the ventral side; I have failed to find these.

Type in the United States National Museum.

Type locality.— Abrolhos Reef, Bahia.

Five specimens dredged in the harbor of Colon, Panama, off Hotel Washington, from 5 fms. depth. Deposited in United States National Museum and Museum of Copenhagen.

Thyone gemmata (Pourtalès)

Plate **17**, figs. 1–3

Colochirus gemmata Pourtalès, 1851, p. 11.
Thyonidium gemmata Selenka, 1867, p. 345.
Thyone gemmata Semper, 1868, p. 138. Théel, 1886, p. 138. Sluiter, 1919, p. 337.
Thyonella gemmata Verrill, 1872, p. 437.

Probably not *Thyone gemmata* Ayres, 1854, p. 246 (posterior prolongations on calcareous ring indicate *Thyone pervicax* Théel), nor *Thyone gemmata* Rathbun, 1879, Bahia.

About 50 specimens examined

Maximum size of preserved specimens, about 15 cm. with the tentacles withdrawn. A slender, tapering form with feet in double rows, along the ambulacra, not crowded, but also spread in the interambulacra; these are cylindrical, but toward the end of the animal they become more papilliform; the skin is rigid, thick, filled with numerous deposits; color mottled brown.

Internally a simple calcareous ring with very long anterior teeth, both on radials and interradials; the posterior margin undulated, but seems never to develop any trace of prolongations; one Polian vesicle

and one small stone canal, embedded in the mesentery; muscle stomach long, slender; intestine very long, attached to the dorsal ambulacrum, turning forward just behind the genital organs (which are situated near the middle of the body cavity), running closely along the left side of the dorsal midline, afterwards running backward again to the cloaca and then taking the usual course across the left dorsal and ventral muscle band, with perforations for the respiratory tree; finally it runs backward, partly attached to the midventral muscle band. The respiratory trees are laterally placed and reach almost to the oral end; their stems are wide, and they have very few secondary branches. The longitudinal musculature is thick and fleshy, band-like, with a deep longitudinal furrow. The thick retractors are attached about one third of the body length behind the oral end. The unbranched genital tubes are numerous and 2–3 cm. long in the mature specimen examined, which was about 15 cm. long; they are fastened near the middle of the body.

Deposits.— Four-holed buttons with small holes and undulated surface with low knobs; their size and shape being very variable; an outer layer of flattened cups with about 8 broad spines. In the cylindrical feet no end plate, only numerous thick, supporting rods with a series of small holes; they are sometimes narrow at the middle, in other cases they have a short third arm; in the conical appendages numerous triangular plates or rods. In the introvert heaps of small rosettes and scattered delicate spectacle-shaped rods: in the tentacles numerous heavy rods, with small perforations.

Type locality.— Sullivan Island, South Carolina.

Type apparently lost.

Ranges from Yucatan to Maine, also in Barbados; quite common along the coast of North and South Carolina; a single specimen from off Potomac River, Virginia, and 2 specimens have been taken off the coast of Maine. (Records all based upon the collections in the United States National Museum.) Shallow water.

Thyone sabanillaensis sp. nov.

Plate **17**, figs. 4–9

Only 2 specimens examined

The largest specimen examined is 11 cm. long and 1.5 cm. wide; slender form, with pentagonal oral and anal ends; oral valves distinct as in a *Colochirus*, composed of stiff, spinelike papillae; appendages arranged in double rows along the ambulacra and at the middle of

the animal scattered in the interambulacra, especially ventrally; near the middle of the animal the feet are partly cylindrical pedicels, partly conical papillae towards the ends. Tentacles withdrawn in both specimens, but examination showed that the ventral were smaller, and they all were much branched and filled with spicules. Skin of medium thickness, filled with deposits; color uniformly grayish.

The calcareous ring has very short posterior prolongations on the radials; the interradials are very little incised posteriorly, and end anteriorly in a pointed tooth almost as long as the radial bifid tooth; a single Polian vesicle and a small stone canal embedded in the dorsal mesentery; long muscle stomach, relatively short intestine of the usual course; the third loop runs along the odd muscle band.

The respiratory trees are, as usual, attached in the lateral ambulacra, the right being the longest; the stem of the trees is wide and the branches fine and thread-like. The musculature is thick and fleshy; the retractors are unusually short, being only one fifth of the total length of the animal.

The unbranched genital organs, which in the specimen examined were ripe and filled with eggs, are placed far back in the last third of the body cavity.

The outer layer of deposits consists of very flattened baskets with 4 spokes, and often a small hole in the brim, corresponding to each spoke; the margin is uneven, with short blunt teeth, or smooth.

The inner layer of deposits consists of plates with several holes, and usually smooth surface, and a great number of four-holed oval buttons of various shapes, with strongly knobbed surface.

In the pedicels no end plate, but several supporting rods, which are thick, slightly curved, and with small holes scattered over the entire length of the rod; in the papillae large triangular plates, with several holes, and often bent in one direction.

Type in the United States National Museum.

Only 2 specimens have been recorded as yet; from Sabanilla, Colombia, collected March 10–12, 1884. Shallow water.

The species seems to be most closely related to *Thyone gemmata*, which it resembles somewhat in its outer shape.

PENTACTA Jaeger 1833

Diagnosis partly after Ekman, 1918.

Tentacles 10, the two ventral much smaller. Appendages more or less distinctly restricted to the ambulacra and developed as cylindrical

pedicels in 3 crowded rows on the ventral side, but towards the ends and in the dorsal ambulacra developed as conical papillae, and much more sparsely distributed; the papillae form (at least around the oral opening) distinct valves.

Calcareous ring simple; other anatomical features seem to be as in *Thyone;* the third loop of the intestine runs along the midventral muscle band.

Deposits numerous, consisting of an outer layer of baskets, an inner layer of knobbed buttons and simple plates, and a number of complicated large deposits; in tentacles and appendages heavy plates or rods; in introvert rosettes.

Type.— *Pentacta doliolum* (Pallas).

Pallas' *C. doliolum* from Cape of Good Hope is usually regarded as the type species. It has never been taken again, and has been regarded by Ludwig and subsequent authors as identical with *Colochirus australis* or *C. minutus*, or finally as Théel's *C. pygmaeus.*

Pallas' figures of *doliolum* are rather poor, if they really pretend to give an idea of *australis*, and the name *doliolum* is somewhat unfortunate for a form which invariably presents itself in the shape of an angulate stick, but the figure and the name are very appropriate for Théel's *Cucumaria discolor* from Cape of Good Hope, and I am almost sure that the latter (which is a real *Pentacta*, after our present definition) is identical with Pallas' much discussed species.

From the West Indian region only one species is known at present.

Pentacta pygmaeus (Théel)

Plate **21**, figs. 10–16

Colochirus pygmaeus Théel, 1886, p. 92, pl. 4, fig. 9. Ludwig, 1892, p. 349 (footnote), Ekman, 1918, p. 32.

Maximum length seems to be about 7 cm. The smallest, easily recognized specimens examined were about 3 cm. in length. It is a characteristic form, of very constant outer shape; short, rectangular, with flattened ventral side with closely packed cylindrical feet in 3 rows, and toward the ends, thick, blunt cylindrical papillae, which form 5 valves around the oral opening; dorsally 2 double rows of similar papillae, which in very old specimens also may spread into the interambulacra. The introvert is thin walled, the tentacles, which in most cases are retracted, filled with spicules; the 2 ventrals are much smaller than the others. Skin thick, filled with deposits; color brown, the pig-

ment often worn off at the ends of the papillae; the animal greatly resembles a piece of not too fresh chocolate candy.

Internally a low, well-developed calcareous ring, the radial pieces are almost heart shaped, with the anterior tooth forming the apex; the interradials are similar in shape but slightly smaller; one Polian vesicle and one small stone canal; short muscle stomach; intestine attached in dorsal interambulacrum near the right muscle band, crossing the left dorsal and ventral muscle bands, and finally running along the left side of the midventral muscle band. The respiratory trees are laterally attached, almost reaching the oral end; the muscle bands are narrow with longitudinal furrow; the thin retractors are attached one third body length from the oral end; the long, unbranched genital organs are attached near the middle of the body.

The deposits are knobbed, regular buttons with 10 globular knobs; roughly speaking, they are present in two sizes, one about half as long as the other. An outer layer of irregular baskets, very hollow, resembling reticulated eggs, and with irregular margin, often incompletely developed. In the cylindrical feet a small end plate may be developed; numerous strong supporting rods, often with a third arm arising from the middle, and perforated at the middle and at the ends. In the papillae these supporting rods are developed as strong, triangular, or irregularly formed plates. In the introvert numerous large rosettes; in the stem of the tentacles strong perforated rods, and in the remaining part numerous rosettes.

Locality.— Bahia.

Type in the British Museum.

Distribution.— This species, which hitherto has been known only from the type, is represented by about 20 specimens in the collections of the United States National Museum. These were all collected in Florida at low tide level, or a few (1–3) fathoms depth.

Remarks.— I have been unable to find any difference between the specimens in the United States National Museum and the small type in the British Museum.

This species belongs apparently to the same group as *P. doliolum* (Pallas) which I regard as identical with *Cucumaria discolor* Théel as recorded by Clark from the Cape of Good Hope. The genus *Pentacta* needs, however, revision, as do the rest of the Dendrochirota.

PSEUDOCOLOCHIRUS gen. nov.

Diagnosis.— Tentacles of equal size; appendages ventrally as cylindrical feet, placed in 3 rows, toward the ends replaced by scattered

papillae; dorsally likewise papillae along the ambulacra, smaller ones may in some species occur in all interambulacra. Skin thick, fleshy, contains very few deposits. Calcareous ring simple; other anatomical features like those of *Pentacta*.

Type.— *Pseudocolochirus violaceus* (Théel).

Théel mentions how unnaturally this form fits into the genus *Pentacta*, and a separate genus has therefore been established to take up all species of this peculiar type. The name has been proposed by Pearson, but was never published.[1]

In the West Indian region this genus is represented by one species.

Pseudocolochirus mysticus sp. nov.

Plate **21**, figs. 7–9

Cucumaria frondosa Pourtalès, 1851, p. 8.

About 20 specimens examined

Short barrel-shaped form, 4–5 cm. long and 3–4 cm. wide. Tentacles of equal size, bushy, with very little calcareous matter, contracted in all specimens examined. Appendages ventrally well expanded, cylindrical pedicels, very soft, arranged in 3 distinct rows; toward oral and anal ends as few, scattered, broad and low papillae, with peculiar dark brown tips; dorsally a zigzag row of similar very low and broad papillae with dark brown tips. Five dark brown anal papillae and 5 small calcareous anal teeth. Integument thick, fleshy, soft, almost devoid of deposits. Color pale yellowish with the remarkable dark brown tips of the papillae.

Internally a low calcareous ring, with short conical anterior teeth and undulated posterior margin; one Polian vesicle and one stone canal, with round head, fastened in the mesentery; short muscle stomach; intestine relatively short; course as usual; the third loop runs along the odd muscle band, attached to the left side of it. Two laterally fastened respiratory trees with wide stem, and few short branches. Musculature well developed; the retractors are attached near the middle of the body; the genital organs form 2 tufts of apparently unbranched tubules; in he specimens examined they were filled with ripe eggs.

Deposits.— Irregular four-holed plates with low knobs; no end plate in the pedicels, only a few almost straight supporting rods, perforated in their entire length with relatively large holes; in the introvert no

[1] In letter to Dr. Mortensen.

deposits were present, but rosettes may be expected; in the tentacles numerous curved slender rods with a few holes in the ends only, decreasing in size towards the ends of the smaller branches, filling the entire tentacles, but without making them especially rigid.

Type locality.— Off Alligator Reef (Pourtalès).

Type in Museum of Comparative Zoölogy.

Twenty well-preserved specimens are in the United States National Museum, from between Charleston and Bermuda, "Albatross" station 2691 (34° 39′ 5″ lat. N., 75° 33′ 35″ long. W., depth 10 fms.

Remarks.— This species is interesting, not so much for its own sake, but because its existence relieves the literature of the remarkable record of the occurrence of *Cucumaria frondosa*, a typical subarctic form, in the tropical waters around Florida. Everybody has doubted the record, but nevertheless it has always been quoted when *C. frondosa* and its distribution was mentioned.

Psolus Oken 1815

Diagnosis.— Tentacles 10; pedicels developed almost exclusively on the ventral sole; besides the ventral sole a few appendages only on the soft-skinned introvert, and in the shape of small papillae, around the anal opening; the whole dorsal side is otherwise devoid of appendages. Body covered with scales, except for the ventral sole and the introvert often with small grains on their surface. In the ventral sole deposits of various kinds, crowded or scattered.

Type species.— *P. phantapus* (Strussenfeldt).

Key to the species of Psolus known from the West Indian Seas and East Coast of the United States

1. Five distinct oral valves 2
1. Not 5 distinct oral valves 6
2. Surface of scales smooth, without any grains (except a few in very old specimens). About 5 dorsal scales between oral and anal scales. Deposits in sole scattered, delicate, four-holed plates with small pearl-like marginal knobs, widely separated from each other. Maximum size about 2 cm. *Psolus valvatus* Oestergren
2. Scales not smooth, covered with grains 3
3. Among the dorsal deposits reticulated grains and small four-spoked cups. Deposits in sole plates, with knobbed surface, sometimes united to an outer network. Attains a length of at least 4 cm. *Psolus complicatus* nov. sp.
3. Among dorsal deposits reticulated grains, no cups 4

4. Exterior, squamata-like, with thin, rounded scales covered with grains. Distinct oral valves with blunt apex not closing the aperture completely; 5 inner narrow "teeth" are sometimes visible; anus surrounded by 2–3 circles of scales in mature specimens 3 cm. long. Deposits in sole, heavy four-holed buttons with large knobs on the margin; the deposits increase in number with advancing age. Largest specimens known, about 3 cm. long . . . . *Psolus operculatus* (Pourtalès)
4. Exterior not squamata-like; scales angular, few, with grains which fuse with scale and form low or high protuberances. Oral valves with pointed apex, closing the aperture completely; inner "teeth" usually not visible; one circle of 5 scales around anus; in small specimens 2–3 scales, in larger ones (2–3 cm. long) apparently 5 scales between oral and anal valves. In sole, perforated plates with usually two large holes, and a variable number of smaller outer holes, knobbed to almost smooth, wide range of variation 5
5. Five small ambulacral scales outside the oral valves. *Psolus tuberculosus* Théel
5. Not 5 small ambulacral scales outside the oral valves. *Psolus tuberculosus* Théel var. *destituta* var. nov.
6. Scales very smooth, without any trace of grains; numerous, about 18 between oral and anal scales. Deposits in sole few, four-holed smooth plates, sometimes only developed as crosses . . . . *Psolus pourtalesii* Théel
6. Scales with grains. In sole, hollow cups with 3–4 holes, in older specimens as complicated reticulated bodies 7
7. Tail-like posterior projection with numerous circles of scales; scales small, numerous and very closely packed. Sole in large specimens small, rectangular; in small specimens of usual form; 3 rows of pedicels; maximum size 15 cm. from oral to anal end . . . . . . *Psolus phantapus* (Strussenfeldt)
7. No tail-like posterior projection; only a few circles of scale around anus. Sole large, of normal size, with feet only along the edge of sole. Maximum length of sole about 19 cm. . . . . *Psolus fabricii* (Düben and Koren)

Psolus valvatus Oestergren

Psolus valvatus Oestergren, 1904, p. 659. Mortensen, 1913, p. 325, 1914, p. 144, figs. 121, 122. Grieg, 1913, p. 139, figs. 7, 8. Ekman, 1923, p. 30–35, fig. 30.
Psolus operculatus Théel (part in 1886, p. 87. Specimen from 43° N., 63° 39′ W., 85 fms.)

A small form, never more than a few cm. long. Large oral valves, also distinct anal valves; about 5 scales between oral and anal end.

Dorsal side covered with relatively large scales, macroscopically apparently smooth; a few grains may very rarely be found.

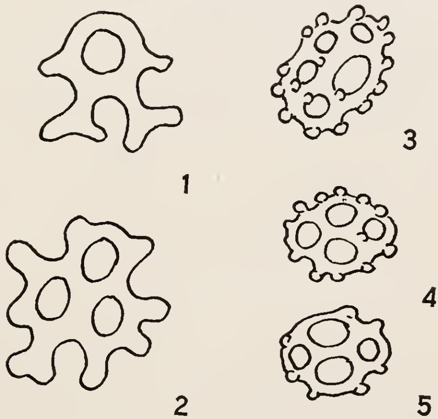
Sole thin; feet confined to the margin.

Internal anatomy not examined.

Deposits.— In the sole, scattered four-holed, very delicate buttons, with small pearl-like knobs on margin.

Type locality.— Coast of Norway; also known from south of Iceland.

This species was taken by the "Albatross" at several stations off New England, always from some hundred fathoms depth.



FIGS. 1–2. Deposits from sole of *Psolus squamatus* Düben and Koren.
FIGS. 3–5. Deposits from sole of *Psolus valvatus* Oestergren. From Mortensen's Denmark's Fauna (× 145).

Remarks.— Ekman has been of the opinion that this species is the young of *P. squamatus.* The text-figures clearly show the difference between the two species. Moreover, *P. squamatus* has never been collected in the western part of the Atlantic Ocean, where *P. valvatus* has been found. The few older records refer all to *P. fabricii* (see p. 192).

PSOLUS COMPLICATUS n. sp.

Plate **19**, figs. 6–9

Psolus operculatus Théel, partim, 1886a, p. 9.

Only one large specimen is at hand, namely the same which Théel very doubtfully referred to *operculatus*, calling attention to the fact that it had some peculiar cups beside the grains on the dorsal side.

A large specimen, the sole about 4 cm in length. Dorsal side very high, vaulted; scales thin, resembling those of *Psolus squamatus;* about 6 dorsal scales between oral and anal scales; oral opening closed by 5 triangular valves; inside these, 5 radial "teeth" and outside, 5 small

radial scales; scales covered with large grains, easily rubbed off. On the sole, only marginal pedicels, those in the outer row much smaller than those in the inner row. Sole parchment-like, rough from the numerous deposits.

Internally not examined.

Deposits in sole, numerous knobbed buttons or plates of variable size; sometimes the knobs unite and form an outer secondary network. The dorsal grains have a platelike basis; the outer part is built up of numerous pillars united by cross beams. Between the grains are numerous four-spoked deep cups with small blunt teeth on the margin.

Type locality.— Off Barbados; depth 137 fms.

Type in the Museum of Comparative Zoölogy.

Psolus tuberculosus Théel

Plate **20**, fig. 3

Psolus tuberculosus Théel, 1886a, p. 13, 14, fig. 5.

The outer aspect of this form is very variable in the different stages, which, in the present material, ranges from less than 1 cm. to about 3 cm. in length. The scales are few, relatively large, and only slightly overlapping; in the smaller specimens they are thin, in the largest specimen thick, on account of the secondary layer of calcareous matter which has developed upon the scales, almost hiding their margins. Some of the animals are almost smooth, with a few larger flat knobs on the scales, while others have several knobs which form short spines, and, in the largest specimen, each of the larger scales has a strong, solid, blunt projection. The oral opening is closed by 5 large valves which close completely, and in most cases it is impossible to see the 5 inner narrow "teeth"; 5 minute scales, almost grains, are placed between the bases of the valves. The anus is surrounded by about 2 circles of scales, well separated from the surrounding large scales. There are 3–4 dorsal scales between the oral and anal scales. The sole is provided with a double row of large feet along the margin beside the outer row of much smaller feet.

Internal anatomy not examined, but from what could be observed through the holes cut in the sole, it is quite normal.

Deposits in sole, perforated plates; often with 2 larger central holes and a number of smaller outer ones; sometimes the difference in size between the holes is very slight. The surface is smooth, with a few knobs in young specimens; entirely knobbed, sometimes forming a secondary outer network in large specimens.

The largest individual is from off Sand Key, Florida, 500 fms. depth; the smaller specimens are from Florida, 120–135 fms. depth; northeast of Tortugas, 101 fms.; Campeche Bay, Mexico, 95 fms.

All in the Museum of Comparative Zoölogy.

Psolus tuberculosus Théel var. destituta var. nov.

Plate **20**, fig. 4

This form differs from typical *tuberculosus* in having a decidedly high forepart, fewer larger scales (only 2 between oral and anal scales, compared to 3 in typical specimens of the same size), and no small scales at the bases of the oral valves.

The deposits in the sole show so much variation that they are of very little help; they are plates of similar size to those in the typical form, but it seems as if they are more knobbed in young specimens, and, with advancing age, become larger and more smooth.

Type locality.— Off Barbados, 73–125 fms., 8 specimens; also Dominica, 118 fms., 1 specimen.

In the Museum of Comparative Zoölogy.

From Barbados there are furthermore 2 small specimens about 1 cm. in length, with abnormally heavy, flattened, and almost smooth scales. I believe they belong to this variety, as they lack the small outer scales around the valves, but the determination is dubious.

Psolus operculatus (Pourtalès)

Plate **20**, figs. 1, 2

Cuviera operculata Pourtalès, 1868, p. 127; 1869, p. 359, 361.
Psolus operculatus Théel, 1886, p. 130; 1886a, p. 12, 13, fig. 4. Ludwig, 1901, p. 159.
Not *Psolus operculatus* Théel, 1886, p. 87.

The type specimens range in size from 1–4 cm. in length. They are extremely "squamata-like" in their appearance, being flattened, with thin, rounded scales, smoothly overlapping and covered with grains, which may be absent in the smallest specimens. Five blunt interradial valves which are unable to close the oral aperture completely, inside these 5 narrow "teeth," and around them 5–12 scales, which are not very different from the ordinary scales of the body. Anus surrounded by a few circles of small scales. Three to five dorsal scales between the oral and anal scales; in the largest specimen, which is incomplete, perhaps 6–7 such scales may have been present. The sole is thin in

small specimens and of medium thickness in large ones; pedicels only along the margin of the sole in an inner crowded row of large feet, and an outer of smaller feet; a few feet at the ends of the odd ambulacrum.

Internal anatomy normal, not studied in detail; the paired dorsal retractors are attached very far back; the paired ventral on a level with the posterior margin of the oral scales, which are near the middle of the body.

Deposits in the sole, heavy four-holed buttons with knobbed margin in the large specimens, also knobs at the middle; the deposits become more solid with smaller holes toward the margin of the sole.

In young specimens the deposits are scattered, with advancing age they become rather crowded, but change very little in character. In the feet a well-developed end plate and numerous supporting rods with some holes.

Type locality.— Off Sand Key, Florida, 120–128 fms. depth.

Types in the Museum of Comparative Zoölogy.

Also from off Key West, Florida, 120–135 fms. depth, and off Barbados, 137 and 103 fms. depth; in the latter locality associated with *Psolus complicatus*, which Théel with some doubt referred to the present species.

Ludwig, 1901, p. 159, records this species from Spitzbergen, from 500 fms. depth; there is good reason for assuming that he is dealing with *Psolus valvatus* Oestergren, which Théel in his "Challenger" report mistook for *Psolus operculatus* Pourtalès.

Psolus pourtalesi Théel

Plate 20, figs. 5–7

Psolus pourtalesi Théel, 1886a, p. 14, pl. 1, fig. 6.

The mature specimens, which seem to be full grown, are all of the same size, about 2–3 cm. long. Dorsal side always flattened, covered with numerous small smooth scales, smoothly overlapping each other; about 18 between oral and anal end; the scales around mouth and anus are arranged in circles and become gradually smaller toward the openings. The ventral side is provided with a zigzag marginal row of large feet and a thin row of much smaller outer pedicels. The integument of the sole is thin, semitransparent, and the internal features are partly visible through the skin.

Internally a simple, well-developed calcareous ring, a small Polian vesicle and small dorsally attached stone canal. Distinct muscle

stomach; intestine attached in the dorsal interambulacrum, nearest the right side, making a large coil, then crossing the left lateral interambulacrum and the ventral left and midventral muscle bands behind the retractors, then running in the right ambulacrum to anus. Respiratory trees well developed, slender, with slender secondary branches; the right attached to its interambulacrum, the left apparently free, shorter, and more bushy. The retractors are relatively short, and the dorsal as well as the ventral pairs are attached about one third body length from the oral end. The genital tubes, which contain ripe eggs in the specimen examined, are few and slender, and as usual in these forms, attached just behind the vascular ring.

Deposits thinly scattered plates, varying from simple crosses to plates with 3–4 holes, usually completely smooth; toward the margin the plates become more solid and have smaller holes. In the pedicels, a large end plate and very heavy branched supporting rods and plates.

Type locality.— East of Nantucket, lat. 41° 24′ 45″ N., long. 65° 35′ 30″ W.; depth 1,242 fms.

Type in the Museum of Comparative Zoölogy.

Psolus phantapus (Strussenfeldt)

Holothuria phantapus Strussenfeldt, 1765.
Psolus laevigatus Ayres, 1854, p. 25, 26.
Psolus granulatus Ayres, 1854, p. 63.
Psolus regalis Verrill, 1866, p. 353. Bell, 1882, p. 646.
Psolus phantapus Verrill, 1874, p. 519. (For other references, see Ludwig, 1901, p. 155, who has a complete bibliography concerning its occurrence in European waters.)

Maximum size of a well-expanded specimen from oral to anal end about 15 cm. Sole in full-grown specimens small, rectangular, with 3 double rows of feet, which are developed even in small specimens, 2–3 cm. long.

Oral and anal ends placed on long projections. Dorsal side covered with numerous, relatively small scales, which in large specimens become very closely packed; even in young specimens they are provided with granules, which increase in number during age; the two names *granulatus* and *laevigatus* have been given to very old specimens; in the first case the grains were very obvious, in the second case, so numerous that they formed an almost smooth covering over the scales.

In young specimens the scales are relatively few, and usually placed along the free edge of the scale. There is no trace of valves around oral

or anal end, both of which are surrounded by a great number of scales arranged in rings, and even in quite small specimens these numerous rings, especially around the anus, form an important distinguishing character to separate the young from small specimens of *Psolus fabricii*. Color of large specimens, almost black.

The internal anatomy offers some features of interest. The calcareous ring is low, with broad anterior radial teeth and more pointed interradial teeth; posterior margin undulated. Single Polian vesicle and a small stone canal embedded in the dorsal mesentery. Long muscle stomach. The first loop of the intestine is much coiled, and runs in the dorsal interambulacrum nearest to the right side, then it crosses the left interambulacrum behind the attachment of the dorsal retractors, which in this species are shifted into the lateral interambulacra, and runs forward, behind the left ventral retractor, crossing the midventral band and runs backward in the right ventral interambulacrum. The respiratory trees are well developed; the right being attached to the right interambulacrum; the left mostly free, very bushy and relatively short.

The muscle bands are fleshy, except that part which runs over the sole; the midventral retractor is attached to the anterior side of the sole; the lateroventral ones are attached near the middle of the sole and the dorsolateral have more or less distinctly shifted out into the lateral interambulacra; in the male examined they were entirely independent of the corresponding muscle bands; in the female examined, from the same locality and of the same size, they had not completely lost their connection with the muscle bands. According to Oestergren's observation (see Dr. Th. Mortensen, 1924), the retractors are placed in the lateral interambulacra at a very early stage.

Deposits.— In the sole, cups with 3–4 broad spokes and blunt teeth in the margin, often with a knob arising from the centrum of the cup eventually developing into a long spine. This type of spicule is visible with low magnification in quite small specimens, 0.5 cm. long, which may be mounted *in toto* in balsam; in old specimens they become more and more numerous and complicated, with secondary rods arising from the margin. In the feet there is a well-developed end plate, and a few rods around the end plate, and cups. In introvert and tentacles, a few perforated plates.

Dorsally there is a layer of reticulated bodies outside the scales; these bodies become more and more numerous and complicated with advancing age.

Type locality.— The Sound, Denmark.

Type not preserved.

Ranges in American waters from off the coast of New England to Labrador. Common along the west coast of Greenland, also from west and south coast of Iceland, coast of Norway to Spitzbergen, coast of Ireland and England, except the southern part. In Denmark it reaches the Sound.

Usually occurring between 20–100 m. depth; according to Ludwig, it is found also in depths up to 400 m.

Remarks.— The development of this species is known; it has a red, free-swimming larva, which sometimes is met with in great numbers. Runnström, 1917, has studied its development.

Psolus fabricii Düben and Koren

Psolus fabricii Düben and Koren, 1846, p. 316. Ludwig, 1901 (complete list of references).

Length of sole up to 10 cm.; outer shape of body very variable, often flattened, edge of sole often uneven. Scales imbricating; in young specimens they are covered with numerous pearl-like granules, which in older specimens often fuse with the scales and form irregular ridges. The number of scales between oral and anal end is about 8–10 in the adult. Around oral opening, 5–6 blunt triangular scales, not forming distinct oral valves; inside these, 5 narrow tooth-like scales; around anus, 5 anal teeth, and outside these 1–2 circles of scales, 5–6 in each circle. Sole thick, leathery, except in very young specimens; feet in double rows; in old specimens there may be up to 4 rows. Odd ambulacrum naked, except in very old specimens, where a complete double row may be present; little difference between the outer and inner row of marginal feet.

Internal anatomy typical for the genus; the retractors are attached to the longitudinal muscle bands as usual.

Deposits.— Specimens 2–3 cm. long already have complicated baskets or ellipses, and with advancing age these deposits become more and more numerous and complicated. In pedicels, end plate, sometimes composed of several pieces, and perforated plates; in tentacles, few curved, perforated plates or rods; usually these disappear with age.

Type locality.— Coast of Norway.

Type not existing.

This species reaches as far south as off Massachusetts, and is quite common at a depth of a few hundred fathoms. In the remaining parts of the Atlantic Ocean it is known from almost the same localities as

Ps. phantapus; it does, however, not extend very far south along the coast of Norway and is not known from off the British Islands.

Remarks.— Old specimens which have been poorly preserved, so that the grains of the scales have been lost, have from time to time been referred to *Ps. squamatus*, and they certainly have some similarity to that species. It has, however, been proved by reëxamination of the specimens in question, that they all belong to *fabricii*, and *squamatus* must therefore be excluded from the list of American Holothurians. (See Ludwig, 1901.) The spicules in the sole are very different; in old specimens of *squamatus* they are scattered, on their way to reabsorption, in old *fabricii* they are numerous, almost crowded and very complicated.

The young of *fabricii* is very easily mistaken for the young of *phantapus;* there is some difference in the spicules, and in the number of scales between oral and anal end, but the question has not yet been satisfactorily worked out.

Thyonepsolus Clark 1901

Diagnosis.— Tentacles 10, the 2 ventral smaller. Dorsal side with scales, some of which are perforated for the passage of feet; these are distributed without any order. Ventral side with distinct sole, with 3 rows of pedicels; third loop of intestine running in left interradius; other anatomical features as in *Psolus*.

Deposits.— In sole, perforated plates and cups; dorsally a distinct layer of deposits outside the scales, consisting of perforated plates, hour glass shaped tables and high, complicated towerlike tables, the latter being especially numerous in young specimens.

Type species.— *Thyonepsolus nutriens* Clark.

Thyonepsolus braziliensis (Théel)

Plate **21**, figs. 1–6

Psolus braziliensis Théel, 1886a, p. 15, fig. 7.

The specimens at hand are either extremely small or in bad condition. The type specimen is 3.2 cm. long with vaulted dorsal side, with numerous small scales and covered outer layer of deposits; the plates are perforated by 1–3 holes for the passage of the dorsal appendages; tentacles 10, the 2 ventral smaller.

Internal anatomy not examined.

Deposits.— In sole, perforated, relatively thin smooth buttons,

irregular, often with 2–4 larger central holes. Dorsally, there is a thin layer of large wide-meshed plates, and a number of the characteristic hour glass shaped tables, which, as far as I know, occur only in this genus. There are also a number of very large towerlike tables, built up of reticulated meshwork. These are most numerous in small specimens.

Type locality.— Porto Seguro, Brazil.

Type in the Museum of Comparative Zoölogy.

Also numerous specimens from Tobago, Buccoo Bay (Clark coll.).

Shallow water form.

Remarks.— It is very extraordinary to find a species of *Thyonepsolus* in the West Indian Seas; the only species hitherto known is from the Bay of Monterey, California. The two species are totally distinct; the Californian species is much smaller when full grown and its spicules are distinctly different, although of the same type.

MOLPADONIA Haeckel

MOLPADIIDAE J. Müller

Diagnosis, from Clark, 1907, p. 135.— More or less elongated, rather stout holothurians, with an anterior, flat, circular oral disk, and generally tapering posteriorly into a more or less evident caudal portion; with well-developed respiratory trees, but with water-vascular system greatly reduced; 15 (in one species only 10) circumoral tentacles, simple or digitate, usually with conspicuous ampullae; radial water vessels are present, but excepting a few very rudimentary papillae at their posterior termination, they are rarely associated with any outgrowth of the body surface; circular muscles interrupted at each radius, and each radial longitudinal muscle usually consists of 2 parallel bands; no special sense organs are present, nor are there ciliated funnels on the mesenteries or wall of the body cavity; calcareous deposits commonly in the form of tables, fusiform rods, or perforated plates, usually present; anchors sometimes occur, but wheels and sigmoid bodies do not; phosphatic deposits often present.

Key to the genera of Molpadiidae which are known from the western part of the Atlantic Ocean

1. A few long whiplike papillae present on the dorsal side . . . .3. *Gephyrothuria*
1. No long whiplike papillae on the dorsal side 2

2. Tentacles with 3–7 short blunt digits, the terminal one large. Phosphatic deposits often present . . . . 1. *Molpadia*
2. Tentacles with two pairs of rather long pointed digits; no terminal digit present . . . . 2. *Caudina*

Molpadia Cuvier 1817

Diagnosis, from Clark, 1907, p. 156. Tentacles 15, with one, sometimes two, rarely 3 pairs of digits, and a terminal digit, which is commonly the largest of all. Body rather stout, usually with distinct, although short, caudal portion, which is generally much less than one third of the total length. Radial piece of the calcareous ring with conspicuous bifurcate prolongations. Calcareous deposits in the form of tables, often very incomplete perforated plates and more or less fusiform rods. In many cases anchors are also present in connection with either a simple irregular plate or a group of 2–8 plates, which are often racket-shaped and form a rosette from which the anchor rises. Phosphatic deposits of a yellow brown or deep red color often present.

Type species.— *M. musculus* Risso.

The genus is not at all satisfactorily known, according to Clark. It seems as if anchors and racket-shaped plates are often most numerous in young specimens, and it is not settled whether the phosphatic bodies are always developed during age or are actually absent in some species. We know practically nothing about the changes which take place in the spicules. In some species, *M. oolitica* and the form which is found in the Arctic sea, it is evident that the spicules decrease with advancing age, in other forms such as *M. musculus* it seems as if a certain type of tables becomes scarce while other deposits increase in number.

Key to the species of Molpadia known from the western part of the Atlantic Ocean, including one from the eastern part

1. Spire of the table distinctly built up of 3 rods united by cross beams; no elongate fusiform rods present, not even in the tail region 2
1. Spire fused into a simple rod, sometimes the base shows indication of three pillars; fusiform rods or tables numerous, especially in the tail region . . 3
2. Tables with 3–10 holes; phosphatic bodies are early present, at first in connection with the margin of the tables, later the tables are reduced and restricted to the tail region, while the rest of the body may become almost black with phosphatic deposits . . . . *M. oolitica* (Verrill)
2. Tables with 6 large central holes and a variable number of outer smaller holes; no phosphatic deposits present, the tables are well developed all through life in all parts of the body . . . . *M. parva* (Théel)

3. Deposits very small, usually with 3 holes in the disc of the tables and sometimes 3 small outer holes; spire usually high, composed of 3 rods which have fused into a slender pillar . . . . *M. blakei* (Théel)
3. Deposits large, usually with more than 3 holes in the disk of the tables, or plates 4
4. Deposits with holes in the prolongations of the spicule; tables with numerous holes in the large disk, often stellate in outline.
(*M. maroccana* Perrier)
4. Deposits with solid prolongations without any perforations 5
5. Regular, almost circular plates with numerous holes, the central ones being the largest; a few smaller but solid heavy tables with 3 large and 3 small holes in disk and simple spire; the fusiform rods in the tail region have 4 small central holes . . . . *M. agassizi* (Théel)
5. No regular circular plates with numerous holes 6
6. Tables with 6 large regularly shaped holes in tables, and often 2–3 short slender projections from the margin of the disk. Few cm. long, immature
M. musculus (Risso)
6. Tables usually with 3–4 holes, a few with 6 holes; marginal projections generally present. Heavy fusiform bodies in the body wall, with 4 large holes, sometimes plate-like with 3 arms. More than a few cm. long.
M. musculus (Risso)

Molpadia oolitica Pourtalès.

Plate **22**, figs. 1–3, 14–18

Chiridota oolitica Pourtalès, 1857, p. 13.
Trochostoma oolitica Théel, partim, 1886, p. 57.
Molpadia oolitica, Clark, partim, 1907, p. 160. Selenka, 1867, p. 357.
Trochostoma antarcticum Théel, 1886a, p. 16.
Embolus pauper Selenka, 1867, p. 359.

The type, abnormally distorted, is about 20 cm. long. Under normal conditions it must have been about 15 cm. long. The outer and inner features seem to be quite typical.

The integument in the type and in the other full-grown specimens I have examined, is packed with phosphatic deposits almost to blackness. The calcareous deposits are practically absent, except near the tail, where small irregular tables are present, with up to 10 holes in the disk and three-pillared spire with several cross beams. These tables are evidently old, and on their way to be resorbed.

From Havana there are 3 small specimens determined by Théel as *Trochostoma antarcticum* with some doubt. As far as I can see, these are the juvenile stage of *M. oolitica*. The tables are numerous, of almost the same size as that species, with three-pillared spire, with cross beams; the disk has larger more perfectly rounded holes, as we

often have it in young specimens. Some are imperfect. A few phosphatic deposits are present, not sufficient in number to discolor the skin, and they are lying in close contact with the margin of some of the tables. The only other species in this region which has similar three-pillared tables is *M. parva* (Théel) and that form seems to retain its spicules throughout life and develops no phosphatic deposits.

Type locality.— Massachusetts Bay.

Type in Museum of Comparative Zoölogy.

Distribution.— From coast of New England; off Charleston (Selenka's *M. pauper*, which by mistake got a label from Cape Palmas into the jar); and from off Havana (Théel's *M. antarctica*). In deeper water, about 600 to 800 fathoms.

The present species has usually been united with the form which occurs in the Arctic sea, *M. jeffreysii* (Danielssen and Koren). The latter species has, however, only one pillar in the tables, and a tendency to have elongated tables in the tail region. I have had occasion to compare Pourtalès' type with several specimens from the Kara Sea, with spicules which agree perfectly with the figures Hérouard has given in 1923, and I think that at present *M. oolitica* is known only from the western part of the Atlantic Ocean.

Molpadia parva (Théel)

Plate **22**, figs. 10–13

Trochostoma arcticum var. *parva* Théel, 1886a, p. 17.
Trochostoma arcticum var. *coeruleum* Théel, ibid., p. 17.
Molpadia parva Clark, 1907, p. 168.

The type specimens are 6–7 cm. long. Color brownish to violet, but without any trace of phosphatic deposits. Internal anatomy not examined. Deposits, tables with three rods in spire and six large and a few smaller holes in the well-developed disk. No fusiform bodies.

Type locality.— Off Grenada in 416 and 583 fms.

Type in the Museum of Comparative Zoölogy.

Distribution.— From the type locality. Also in the Caribbean Sea and south of Nantucket (see Clark).

Molpadia blakei (Théel)

Plate **22**, figs. 19–23

Trochostoma blakei Théel, 1886a, p. 16, pl. 1, fig. 8.
Molpadia blakei Clark, 1907, p. 163.

Few cm. long, thin walled, with short tail. Skin finely rough. Internal anatomy not peculiar. The mesentery is very delicate, composed

of wide-meshed network. Respiratory trees long and slender; the left one has practically no lateral branches. Genital organs in the specimen examined, short fingerlike tubes, arranged in 2 tufts near the oral end.

Deposits.— Extremely small tables, commonly with 3 regular holes, sometimes 1–3 small outer holes besides. Spire high, in most cases composed of 3 rods, which fuse into a simple pillar. In the caudal part more elongate tables with a low spire ending in 2 or 3 hooks.

Type locality.— Off Grenada, from 955 fathoms depth.

Type in the Museum of Comparative Zoölogy.

Hérouard, 1923, p. 137, pl. 9, figs. 13–16 and 21–32, describes two varieties, namely *grossularia* and *excentrica* from the eastern part of the Atlantic Ocean. I have been unable to find sufficient distinguishing characters between the type form and these two varieties, but such may exist. We know too little about the range of variation of spicules in the single species, or even one individual, to judge whether these differences are of importance or not.

A third form, *M. blakei* var. *groenlandica* Mortensen from Greenland is, according to Hérouard, related not to *blakei,* but to one of the other Arctic forms, *M. jeffreysii* (Danielssen and Koren).

M. angulata (Hérouard), 1923, from off Nova Scotia, 5,270 m. depth, seems to me to be so closely related to *M. blakei* that I do not think it can be kept separate.

It is remarkable to note the varied depths in which these forms live.

Molpadia maroccana Perrier

M. maroccana Perrier, 1898, p. 1666; 1901, p. 533, pl. 22, figs. 9–15. Clark, 1907, p. 166, pl. 10, figs. 17, 18.

This species is well characterized by its large tables with numerous holes, and often star-shaped outline with perforations in the marginal projections. The fusiform bodies are also perforated by numerous holes, which likewise extend into the projections. Hérouard believes it to be a variety belonging to the *musculus* group, but I think the spicules, which are of the size found in *musculus,* are so different that it is natural to regard the species as distinct.

Known only from the type locality, off Morocco, from 221 m. depth.

Molpadia agassizi (Théel)

Plate **23**, figs. 1–3

Ankyroderma agassizi Théel, 1886a, p. 19.
Molpadia agassizi Clark, 1907, p. 169.

The type specimen is about 5–6 cm. long and quite colorless, with a stiff and glassy integument; caudal portion short.

Internal anatomy not examined.

Its deposits are very characteristic, large circular plates, perforated by numerous holes, which decrease in size toward the margin. Besides we find smaller tables with 3–4 holes and the rudiments of a one-pillared spire. In the tail, long slender rods, perforated by 4 small holes at the middle. Tables are probably more common in young specimens. No trace of phosphatic deposits are present, and as the animal seems to be mature, they are most likely always totally absent in this species.

Type locality.— Off Bequia, from 2,712 m. depth.

Also from off Grenada, and no loc., 1904 m. depth.

The types, which are the only known specimens, are in the Museum of Comparative Zoölogy.

Molpadia musculus (Risso)

Plate **22**, figs. 4–9. Plate **23**, figs. 4–7

M. musculus Clark, 1907, p. 165, pl. 11. Complete list of references. Perrier, 1901, p. 529, pl. 22, figs. 16–22. Hérouard, 1923, p. 132, pl. 5, fig. 1.
M. oolitica Théel, 1886a, p. 18. Clark, 1907, p. 160 (partim).
M. loricata Perrier, 1901, p. 535, pl. 22, figs. 23–28. Hérouard, 1923, p. 133.
Trochostoma affinis Théel, 1886a, p. 20. Clark, 1907, p. 163 (partim).

Fully grown specimens measure about 8 cm. The integument is thin, with numerous phosphatic bodies scattered more or less densely. Caudal appendages short. Inner anatomy as usual.

The spicules in the fully grown specimens are represented by relatively few, regular tables, with 6 large holes and 2–3 slender projections from the margin; the spire is a simple rod. Beside these, numerous very large fusiform bodies with usually 3–4 central holes, and generally no trace of a spire and 2, rarely 3 long, solid, marginal projections. In the tail region, long slender rods with 4 central holes. In a single individual, which was exceptionally large, I found plates with more holes, thus resembling the deposits of *M. loricata* Perrier which, as far as I can see, is simply an old specimen of *M. musculus.*

Small specimens a few cm. long have only tables with marginal projections and solid spire. The large fusiform plates are totally absent from the body wall. The fusiform rods in the tail region are smaller, but it seems evident that they increase in size with advancing age in this species.

Comparison of the spicules of those small specimens which Théel has labeled *A. affinis,* with figures of the spicules of the Arctic form *M. affinis* (Danielsen and Koren) shows that the two forms are not

identical; the Arctic form has tables in which the holes throughout life are never closed, and of much more irregular shape.

M. musculus seems to be a truly circumequatorial species, as Perrier has already pointed out. The specimens from the West Indies have been compared with those which Ludwig described as *musculus* from the Gulf of Panama, and when the great individual variability of the spicules is considered, no important differences can be noted. A specimen labeled *musculus* from off Chile seems, however, to be a slightly different form.

The species is represented from the following localities in the West Indies and off the coast of New England: off Grenada, Gulf of Mexico, off South Carolina, off Nantucket.

The young specimens, labeled *affinis* by Théel, were from off Dominica, in 391 fms.

Distribution.— The species seems to be common off the European coasts and off the coast of North and Central America. Also common in the Indo-Pacific. It seems, however, to have been so often confused with other forms that nothing definitely can be said about its actual limits, nor about the depth wherein it occurs. Usually it is from 100 to 500 fathoms.

(Molpadia turgida Verrill

Trochostoma turgida Verrill, 1879, p. 473; 1885, p. 538. Théel, 1886, p. 52. Clark, 1907, p. 164.

The tables are very regular, with high spire, and the dish is more or less regular with 12–40 holes.

Color reddish or purplish brown, skin thin, semitranslucent.

Type locality.— Massachusetts Bay from 72–180 m. depth, also from Gulf of St. Lawrence, Gulf of Maine, Casco Bay, etc.

According to Verrill, 1885, p. 538, it is not uncommon.

This species is not included in the key, as I have seen no specimens which could be referred to it.)

Caudina Stimpson 1853

Diagnosis, from Clark, 1907, p. 172.— Tentacles 15, with 2 pairs of digits, the distal pair longer than the proximal; no terminal unpaired digit. Body rather stout, more or less tapering posteriorly, and usually with a distinct caudal portion, which is generally one-third of the total length or even more. Radial pieces of calcareous ring with conspicuous bifurcate posterior prolongations. Calcareous deposits of

very various kinds, with no particular kind characteristic of the genus. Phosphatic deposits are usually entirely wanting, and are known to occur in one species only.

Type species.— *C. arenata* Gould.

Key to the species known from the western part of the Atlantic Ocean

1. Calcareous deposits four-spoked disks, with marginal knobs. *C. obesacauda* Clark
1. Calcareous deposits tables.
2. Disk of tables about 90–140 μ in diameter; spire rather low and irregular, usually with 4 somewhat converging rods............*C. arenata* Gould
2. Disk of tables about 150–270 μ in diameter; spire high with strong spines, apparently consisting of 3 converging rods..........*C. albicans* (Théel)

Caudina arenata Gould

Plate **24**, figs. 2–5

Caudina arenata Gould, 1841, p. 345. Théel, 1886, p. 54. Gerould, 1895, p. 123, 190, pl. 1–8. Clark, 1907, p. 174, p. 10, figs. 1, 2, 11. Hérouard, 1923, p. 139, pl. 2, fig. 3; pl. 5, fig. 9.

Maximum length up to 25 cm., but most specimens are much smaller. A relatively slender form; the tail forms a large part of the animal. Tentacles with 4 pointed digits, rarely contracted. Internally, a calcareous ring of the usual type, with long radial posterior prolongations with bifid end. A small ventral Polian vesicle, dorsally a small, coiled stone canal, attached to the anterior margin of the mesentery. Long muscle stomach, intestine relatively short; the first loop runs closely along the right dorsal muscle band to the beginning of the cloaca; the second loop runs forward along the lower side of the left dorsal muscle band; both loops are attached by narrow complete membranes. The third loop, which is a much wider tube than the rest of the intestine, is attached by numerous long strands to the upper margin of the two lateroventral muscle bands. A fine rete mirabile is connected, essentially with the first loop.

The respiratory trees are long and slender, with small secondary tufts. The right is undivided; the left has an upper dorsal branch entangled in the rete mirabile; the other is apparently free. The musculature is well developed; the longitudinal bands are fleshy and completely divided.

The genital organs are arranged in two tufts near the oral end;

they consist of long tubules several times divided. In the specimen examined they fill the entire body cavity.

Deposits.— Numerous large tables with 4 central holes and 8–10 outer holes, margin knobbed; spire low, strong, with numerous teeth on the top. It is difficult to decide whether the spire is composed of 2 or 4 rods. We also find a number of oval four-holed buttons with two large and two small holes, and a number of knobs on the margin and between the holes.

Type locality.— Coast of New England, at present only known from that region. It is usually washed up on shore after heavy storms, and undoubtedly lives buried in the bottom. Clark gives its bathymetrical range from 1 to 35 m. Hérouard reports this species from 0–1000 m. and 1,458 m., but such records require confirmation.

Caudina obesacauda Clark

Plate **24**, figs. 6–8

C. obesacauda Clark, 1907, p. 38, 176, pl. 9, figs. 1–5.

Ten to fifteen cm. long. A stout form, often with the tail indistinctly set off. On the whole it is more robust than *C. arenata.* Internal anatomy seems to agree in all details with that species; the left respiratory tree seems to have a few accessory branches near the base.

The deposits are peculiar, regular four-spoked buttons or flattened closed baskets with a number of knobs.

Only known from the type locality, Marco, Florida, and from Galveston, Texas.

It seems to be very closely related to *C. chilensis* Müller. Its spicules have been compared with those of a specimen of *chilensis* from New Zealand, and there is some difference between them, but how constant this may prove to be it is impossible to tell at present.

Caudina albicans (Théel)

Plate **24**, fig. 1

Trochostoma albicans Théel, 1886, p. 44, pl. 3, fig. 2; pl. 11, figs. 3, 9, 10.

T. albicans var. *glabra* Théel, 1886, p. 46. Koehler and Vaney, 1905, p. 89. Perrier, 1901, p. 526, pl. 22, figs. 7, 8.

T. arenata var. *armata* Théel, 1886a, p. 17.

Caudina arenata var. *armata* Gerould, 1896, p. 19, pl. 3, figs. 34–37.

Specimens 7.5–11.5 cm. long have hitherto been collected only. The caudal portion is very long and slender. The skin is rough, and semitransparent.

Deposits.— Very large tables with strong spinous spire, apparently built up of 2 rods.

Type locality.— "Challenger" station 45, south of Nova Scotia; depth 1,240 fms.

Also taken from off Cape Cod, 1,600 m.; off Cape Hatteras, 2,235 m. Reported also by Perrier from off Senegal, 3,200 m. and by Koehler and Vaney from Gulf of Bengal. No difference can be found in the figures of the spicules which the different authors give. There is also a variety *T. albicans* var. *glabra* Théel from off New Zealand; it has not been compared with any of the Atlantic specimens.

Gephyrothuria Koehler and Vaney

Syn. *Himasthlephora* Clark, 1907

Diagnosis, after Koehler and Vaney, 1905.— Body form recalling that of a *Molpadia;* mouth terminal surrounded by 15 tentacles, which end in a pair of lobes. The oral end is slightly narrower than the remaining part of the body. Each of the dorsal ambulacra carries a series of few, very slender appendages, but the ventral side is naked, or provided with very small appendages; anal papillae present. Calcareous bodies seem to be entirely lacking in body wall; some deformed deposits may be present in the tentacles. Two respiratory trees are present, each developed as a short tube with few lobes.

Type species.— *G. alcocki* Koehler and Vaney.

This genus has previously been put in the Order Molpadonia, but Hérouard (1923) placed it among the Synallactidae, near to *Pseudostichopus*, and he united Clark's *Himasthlephora*, which was distinguished by having 2 pairs of lobes on tentacles and long genital papillae; its long caudal appendage being only an ejected portion of the intestine.

Further investigation will be necessary, before the natural position of this form can be correctly determined.

Only one species seems to occur in the Atlantic Ocean.

Gephyrothuria glauca (Clark)

Himasthlephora glauca Clark, 1907, p. 40, 184, pl. 13, figs. 1–4.
Gephyrothuria europeensis Hérouard, 1923, p. 30, pl. 9, figs. 10a-b.

Fifteen small tentacles of very equal size, partly retracted so that their exact form could not be determined; according to Clark there are small fingerlike lobes; mouth and anus terminal, mouth not retracted.

Body cylindrical with 4–5 long whiplash-like appendages on dorsal side in each ambulacrum; small tubelike projections are also found on most parts of body; Hérouard regards these projections as appendages similar to those found in *Pseudostichopus*. Anus is surrounded by some large typical anal papillae; the caudal appendage which Clark described is simply a part of the intestine, which seems to be ejected when the animal is captured. Skin thin, grayish, semitransparent; Hérouard notes that some brownish spots are present on his specimen.

As the internal anatomy is very fragmentary in the two specimens I have examined, the following is partly quoted from Clark and Hérouard. The calcareous ring is solid with 10 pieces; the radial and interradial pieces being of almost the same size and height, very little incised in front, almost straight posteriorly; no author mentions Polian vesicle or stone canal; a short oesophagus (muscle stomach?) is present; the intestine seems to have the normal course. Respiratory trees are well developed, the right being attached to the right ventral interambulacrum, the left being shorter and more bushy. Muscle bands thin, undivided, as in a *Pseudostichopus*. Genital organs and tubes in tufts on each side of mesentery, which according to Hérouard is reduced to mere threads; the duct opens on dorsal side in the midline, with a long conical papilla (in both sexes?).

Deposits.— No deposits in body wall; in tentacles I have found some heaps of very irregularly shaped deposits, of a form which give us no help in solving the systematic position of this peculiar form.

Type locality.— Off Georgia, "Albatross" station 3,678; depth 2,632 m.

Types in the United States National Museum, Washington and in the Museum of Comparative Zoölogy.

Remarks.— I have been quite unable from Clark's and Hérouard's description to find anything which indicates that the two species, *glauca* and *europeensis*, are different. Unfortunately Hérouard does not compare his species with that of Clark; he simply mentions that *Himasthlephora* is congeneric with *Gephyrothuria*.

APODA Brandt 1835

Diagnosis, from Clark, 1907, p. 42.— More or less cylindrical elongated Holothurians with terminal mouth, without respiratory trees and with water-vascular system greatly reduced; circumoral tentacles, either simple, pinnate or digitate are present, but lack ampullae; there are no pedicels or papillae; circular muscles of body wall con-

tinous, i.e. not broken or interrupted at radii; characteristic sense organs (positional organs) present, situated beside radial nerves near nerve rind; minute ciliated funnels, apparently having an excretory function, usually present in body cavity on or near mesentery; calcareous deposits in form of anchors and plates, wheels or sigmoid bodies usually present, but no tables or phosphatic deposits occur.

Three families are known, two of which are treated in the present paper.

Key to the families

1. No wheels, sigmoid or bracket-shaped particles present in the integument, but usually anchors and perforated plates; deposits rarely wholly wanting; tentacles never peltate-digitate .... Fam. *Synaptidae* Oestergren
1. Wheels, sigmoid or bracket-shaped particles commonly present in the integument; deposits sometimes wholly wanting; tentacles commonly peltate-digitate 2
2. Wheels present or wanting; if present, not normally with more than 6 spokes Fam. *Chiridotidae* Oestergren
2. Wheels present, with 8 or more spokes . . (Fam. *Myriotrochidae* Oestergren)

SYNAPTIDAE Oestergren 1898

Diagnosis, from Clark, 1907, p. 70.— Tentacles with stalk, cylindrical or terete, not becoming widened distally, either with digits along each side for most of its length (pinnate) or with only one or two digits on each side near the tip (digitate) or without digits at all (simple). Calcareous deposits usually anchors and perforated plates (anchor-plates), often accompanied by irregular curved rods or minute particles (miliary grains) but any of these may be wanting. Hermaphroditic so far as known, except possibly the genus *Rhabdomolgus*.

Key to the genera known from the western Atlantic region

Clark, 1907, p. 71.— (The genera from the region here studied belong, as far as our present knowledge goes, to the group which has anchors and anchor plates. For other genera see Clark.)

1. Arms of anchors smooth, vertex usually with minute knob-like projections . 2
1. Arms of anchors usually serrate; vertex usually smooth, without knobs . . . 3
2. Stock of anchors branched irregularly; large forms with numerous digits on side of tentacles .... *Euapta* Oestergren
2. Stock of anchors not branched; the large holes in anchor plates dentate and regularly arranged .... *Synaptula* Oersted

3. Tentacles pinnate, 5–21, usually more than 7, digits or simply pinnately notched without digits . . . . *Leptosynapta* Verrill
3. Tentacles digitate with 3–5 digits; anchor plates not narrowed into a handle. *Protankyra* Oestergren

Euapta Oestergren 1898

Diagnosis, from Clark, 1907, p. 73.— Fifteen tentacles (young, 13–14), with 10–35 digits on each side; cartilaginous ring usually present. Numerous Polian vesicles; stone canal one or more; often pigment eyes at base of tentacles.

Stock of anchor distinctly branched, arms smooth; vertex with some minute knobs; anchor plates with large central holes surrounded by 6, rarely 7 other large holes, all more or less dentate, and with several holes of variable size and arrangement (one on each side large) but with smooth margin at posterior end, where a well-formed and arched bow crosses the outer surface of plate.

Type species.— *E. lappa* (J. Müller).

Euapta lappa (J. Müller)

Synapta lappa J. Müller, 1850, p. 134.
Euapta lappa Clark, 1907, p. 73, pl. 4, figs. 23–25; 1924, p. 464, pl. 1, figs. 5–7. Sluiter, 1910, p. 335. Deichmann, 1926, p. 26.

Maximum length, one meter. Color silvery gray, often longitudinally striped.

The species cannot be confused with any other form in West Indian waters. A parallel form *E. godeffroyi* Semper occurs in the Pacific Ocean with smaller anchors and other minute differences in the spicules.

Type locality.— "West India."

Ranging from the coast of tropical America all over the Caribbean Sea; not yet known from Bermuda. Recorded from Teneriffe (Théel).

Typical shallow water form, usually found beneath dead coral blocks.

Synaptula Oersted, 1849

Diagnosis, from Clark, 1907, p. 80.— Tentacles pinnate, 10–15; at least 5 digits on each side; calcareous ring present; 3 or more Polian vesicles; single unbranched stone canal. Senseorgans in formof pigment eyes at the base of tentacles on oral disk often present.

Stock of anchors finely toothed but not branched. Arms smooth, but vertex with a few minute knobs; anchor plates with a large central

hole, surrounded by 6 other large holes, all more or less dentate, and with two large smooth holes at the narrow posterior end, where a well-formed and distinctly arched bow crosses outer surface of plate.

Type species.— *S. hydriformis* (Lesueur).

Synaptula hydriformis (Lesueur)

Holothuria hydriformis Lesueur, 1823, p. 162.
Synaptula hydriformis Clark, 1907, p. 23, 82, pl. 6; 1924, p. 473, pl. 3, figs. 5–6; pl. 4, fig. 4. Deichmann, 1926, p. 27.

A small species, a few cm. in length; common from Brazil to Bermuda; found in shallow water.

Viviparous.

Leptosynapta Verrill 1867

Diagnosis, after Clark, 1907, p. 86.— Tentacles pinnate, 10–13. Digits usually 4 or more on each side (rarely 3 or only 2 or none). Cartilaginous ring wanting. Polian vesicles usually single, rarely more than one. Stone canal single, unbranched. Sense organs never in form of pigment eyes, but as minute cups, probably olfactory, on inner surface of stalk of tentacles. Stock of anchors finely toothed but not branched; arm usually with upwardly or outwardly projecting teeth on outer edge; vertex smooth. Anchor plates oval or somewhat elongate, with large central hole, surrounded by 6 other large holes, usually more or less dentate and without any arched bow across the outer surface; at the broad end there are often additional holes; a few species have a greater number of holes.

Type species.— *Leptosynapta inhaerens* (O. F. Müller).

Key to the species of Leptosynapta from the western part of the Atlantic Ocean

1. Anchor and anchor plates extremely large (300–600 μ in length), at least some of them near the anal end, smaller anchors and anchor plates may be intermingled with the large ones 2
1. Anchor and anchor plates small (200 μ or less) 4
2. Anchor with 3 teeth on each arm; anchor plates not especially oblong in outlines, with 7 regular holes arranged in a rosette; numerous granules present . . . . *L. multigranulata* Clark
2. Anchor with 6–9 teeth on each arm; large anchor plates, distinctly oblong with numerous holes (10–20), not in a regular rosette 3
3. Granules present . . . . *L. acanthia* Clark

3. No granules present . . . . *L. multipora* Clark
4. Anchor plates almost circular, practically devoid of teeth in the large holes; no miliary grains present . . . . *L. circopatina* Clark
4. Anchor plates more or less oblong, with indistinct to distinct teeth in the large holes 5
5. Arms of anchor very widely spread; anchor usually longer than anchor plates, which usually are more than 140 μ in length. Scattered groups of miliary grains, mostly oblong in shape . . . . . . *L. inhaerens* (O. F. Müller)
5. Arms of anchor not widely spread; anchor plates less than 140 μ in length 6
6. Anchor plates relatively robust and up to 140 μ in length, often distinctly oblong; anchors slightly longer than anchor plates; miliary grains in groups of 4–5, scattered . . . . *L. crassipatina* Clark
6. Anchor plates not distinctly oblong, less than 110 μ in length; no miliary grains present 7
7. Anchor plates with distinct teeth on inner edge of the large holes; anchors distinctly longer than anchor plates . . . . *L. roseola* Verrill
7. Anchor plates with teeth poorly developed on inner edge of the large holes; anchors as long as anchor plates, often without teeth on arms. *L. parvipatina* Clark

Leptosynapta multigranulata Clark

Leptosynapta multigranulata Clark, 1924, p. 486, pl. 8, figs. 3–7.

Few cm. long; resembles *inhaerens* superficially, but its spicules are entirely different.

Type locality.— Tortugas, Florida.

Type in the Museum of Comparative Zoölogy.

Shallow water form, taken among roots of eel grass.

Leptosynapta acanthia Clark

Synapta acanthia Clark, 1899, p. 126.
Leptosynapta acanthia Clark, 1907, p. 92; 1924, p. 477, pl. 6, figs. 12–16.

Up to 35 cm. in length; found in shallow water.

Type locality.— Bermuda.

Type in the Museum of Comparative Zoölogy.

Not known from any locality outside Bermuda.

Leptosynapta multipora Clark

Leptosynapta multipora Clark, 1924, p. 488, pl. 9, figs. 1–5.

Length in life up to 9 cm.

Type locality.— Kingston Harbor, Jamaica.

Type in Museum of Comparative Zoölogy.

Taken from sand bottom.

Leptosynapta circopatina Clark

Leptosynapta circopatina Clark, 1924, p. 478, pl. 4, figs. 6, 7.

Only a single specimen, a few cm. long, has been collected.

Type locality.— Port Royal, Jamaica.

Type in Museum of Comparative Zoölogy.

Taken under a brick at low water.

Leptosynapta inhaerens (O. F. Müller)

Holothuria inhaerens O. F. Müller, 1776, p. 232.
Leptosynapta inhaerens Clark, 1907, p. 88, pl. 5, figs. 14, 15, 18, 20 (complete list of references); 1924, p. 483, pl. 7, figs. 12–16.
L. gracilis Selenka, 1867.

Maximum size 15 cm. The specimens which have been examined are from the coast of New England. The species ranges apparently from Maine to South Carolina and is also reported from Bermuda.

Oestergren suggests (1898) that American specimens belong to a different species from the Norwegian, and I believe he is right.

The question has been very carefully discussed by Clark in 1924.

Leptosynapta crassipatina Clark

Leptosynapta crassipatina Clark, 1924, p. 479, pl. 6, figs. 1–4.

Grows to the same size as *inhaerens*.

Type locality.— Key West, Florida.

Type in the Museum of Comparative Zoölogy.

Taken from sandy mud.

Leptosynapta parvipatina Clark

Leptosynapta parvipatina Clark, 1924, p. 490, pl. 4, figs. 8, 9; pl. 6, figs. 5–8.

Length 4–5 cm.

Type locality.— Buccoo Bay, Tobago.

Type in the Museum of Comparative Zoölogy.

From muddy sand.

Protankyra Oestergren 1898

Diagnosis, from Clark.— Tentacles digitate, 12 in number. Digits 2 (rarely one only), on each side. Cartilaginous ring wanting. Polian vesicles 2–10, or rarely only one. Stone canals usually single, but rarely there are several.

Stock of anchors more or less branched, or only finely toothed; arms usually serrate; vertex without knobs. Anchor plates without a handle, with numerous irregular perforations, and with a more or less imperfectly developed bow across outer surface of posterior end; plates and perforations also with either smooth or dentate margins.

Type species.— *P. benedeni* (Ludwig).

Key to the species of Protankyra known from the western part of the Atlantic Ocean

1. Anchor plate with extremely small holes; handle broad; strong teeth on arm and anchors, reaching the tip of the anchor arms ...... *P. brychia* Verrill
1. Anchor plate with well-developed holes, narrow or irregular handle 2
2. Anchor plate simple without irregular network. Anchors with teeth only on some part of the arms not reaching the tips. Shallow water form. *P. benedeni* (Ludwig)
2. Anchor plates with irregular network; anchors with teeth reaching the tip of anchor arms. Deep-sea form .... *P. abyssicola* (Théel)

Protankyra brychia Verrill

Protankyra brychia Verrill, 1885, p. 539; Clark, 1907, p. 103, pl. 4, figs. 12–14.

Of this species only a few, imperfect specimens are known; the spicules are, however, very characteristic.

Type locality.— Off Cape Hatteras; depth 1,688 m.

Type in the United States National Museum.

Known only from the type locality.

Protankyra benedeni (Ludwig)

Synapta benedeni Ludwig, 1881, p. 55, pl. 3, figs. 19, 20. Clark, 1907, p. 103.

Ludwig's description.— Three specimens are at hand, respectively 2.3, 3 and 3.5 cm. long; the following description is essentially based upon the second specimen. This has a diameter of 8 mm. The twelve tentacles resembling in their shape that of *Synapta digitata;* besides a short terminal one, each tentacle has on each side only 2 larger digits. Color whitish, the thin integument renders the muscle band visible. The entire habitus recalls that of *S. digitata*.

The anchors are 0.62 mm. long and provided with a few blunt teeth near the ends of the arms; the anchor plates have a length of 0.48 mm.; approximating in their shape that of *S. pseudodigitata* Semper and

S. similis Semper, the holes in the anchor plates are, however, provided with irregularly distributed spines.

Beside these, we find in the integument numerous dumbbell-shaped bodies, the so-called miliary grains (0.025 mm. long).

The longitudinal muscle band becomes narrower from oral end to anal end; in the anterior part of the body cavity they are almost as broad as the intermuscular areas. Six Polian vesicles, 2–4 mm. long, attached to the vascular ring. In dorsal mesentery there is a single stone canal embedded, with rounded head, forwardly directed and coiled.

A small bundle of short genital organs at most once divided are placed left and right to the dorsal mesentery; they are not functioning in the specimen examined, as neither distinct sperma nor egg cells could be traced. The opening of the oral sinus is relatively large; it occupies the entire diastema between the tentacle canals.

The intestine is coiled and the coils reach into the anterior and posterior part of the body cavity. I have missed the ciliated funnels in the mesentery on the first part of the intestine, and found a few on its second, forward-running loop, and numerous on the third backwards running loop; but ciliated funnels seem never to migrate out upon the wall of the body cavity.

Type locality.— Coast of Brazil.

Type, most likely in Bruxelles.

Remarks.— Not known from other localities. Ludwig's figures show an anchor plate and anchor, clearly proving that it is distinct from the related forms. It has never been taken again.

PROTANKYRA ABYSSICOLA (Théel)

Synapta abyssicola Théel, 1886, p. 14, pl. 1, fig. 11.
Protankyra abyssicola Clark, 1907, p. 105, p. 4, figs. 8–11; 1924, p. 11, pl. 11, figs. 6, 7, pl. 12, fig. 1.

I have examined the fragments from off New Jersey, depth 1,394 fathoms. The specimen is too poor to allow a real comparison with *P. pacificus* Ludwig, from off west coast of South America, which by some authors is regarded as identical with the Atlantic species.

In the Atlantic Ocean this species ranges from the coast of New Jersey and Gulf of Mexico to Senegal; depth between 2,000–3,000 m.

CHIRIDOTIDAE Oestergren 1898

Diagnosis, after Clark, 1907, p. 112.— Tentacle with stalk short, becoming widened toward the ends where it bears 3–10 digits on each

side; the digit-bearing portion forms a sort of disk which can, in many cases (perhaps always?), be drawn downward in contraction, more or less into the basal portion of the stalk; such tentacles may be called peltately digitate; cartilaginous ring wanting; stone canal single; eye pits wanting; genital organs seldom present; calcareous deposits either six-spoked wheels or conspicuous sigmoid or C-shaped bodies, or both, often accompanied by curved or straight rods or oval miliary granules; rarely minute curved rods only are present, or deposits are wholly wanting. Sexes apparently separate in many species, perhaps in all.

Key to the genera known from the western part of the Atlantic Ocean

For all other genera, see Clark, 1907, p. 112

1. No sigmoid bodies; wheels present, collected in little papillae; tentacles 12; ciliated funnels mostly single and scattered........*Chiridota* Eschsholtz
1. Wheels wanting; minute curved rods present............*Toxodora* Verrill

Chiridota Eschscholtz 1829

For synonyms, see Clark, p. 113

Diagnosis.— Tentacles 12, exceptionally 13 or even 14. Digits 2–10 on each side, the terminal pair longest. Polian vesicles numerous, 3–20. No gustatory organs are known to occur. Ciliated funnels usually single, sometimes collected into little groups, but not forming true stalked clusters. Calcareous deposits in the form of six-spoked wheels, collected in little papillae, containing 10–80 of divers sizes. No sigmoid bodies, but small curved rods with enlarged ends are often present, and minute oval miliary grains, or somewhat large rod-shaped particles, frequently occur in connection with the longitudinal muscles.

Key to the species known from the western part of the Atlantic Ocean

1. In integument, no curved rods; wheel-papillae very few, large. *Chiridota laevis* (Fabricius)
1. In integument, curved rods..2
2. A thin, scattered layer of curved rods; wheel-papillae abundant; wheels of very variable size, up to 0.2 mm. wide........*Chiridota rotifera* Pourtalès
2. A crowded layer of curved rods; wheel-papillae few (?). Wheels mostly of large size, more than 0.2 mm. wide...........*Chiridota pelorica* nov. sp.

Chiridota laevis (Fabricius)

Holothuria laevis Fabricius, 1780, p. 353.
Chiridota laevis Clark, 1907, p. 119 (complete list of references).
Chiridota typica Selenka, 1867, p. 366.

The question about the various species which are united under this name is yet unsettled (see Clark, 1907, p. 29, 119).

In the following, only the species is considered described by Selenka as *C. typica* from Massachusetts Bay.

The specimens are a few cm. long, with 12 tentacles of the typical shape, short with 2–3 pairs of digits; the terminal pair is longest. Integument semitransparent; large heaps of deposits scattered along the interradials, most numerous posteriorly.

Internally not examined.

Nothing can, at present, be said about the distribution of this species. From off the Azores v. Marenzeller describes a species as *C. abyssicola* (1893, pl. 19, pl. 1, fig. 5; pl. 2, fig. 7). It has wheels which are about 0.08–0.1 mm. in diameter. These dimensions are similar to average wheels in Selenka's specimens, but much larger wheels are found in the ones before me; the wheels of *Chiridota* are, however, so little known, that no conclusion can be drawn about the importance of the size. Marenzeller notes that his specimen is closely related to the Arctic form, but thinks it is better to keep them separate.

Chiridota rotifera Pourtalès

Synapta rotifera Pourtalès, 1851, p. 15. Ludwig, 1881, p. 41, pl. 3, figs. 1–15. Clark, 1907, p. 115. Sluiter, 1910, p. 341.

A very characteristic form, which grows to a length of about 10 cm. Numerous wheel papillae, which contain a number of wheels of very various size, from less than 0.1 mm. to 0.2 mm.; curved rods are thinly scattered.

Type locality.— Biscayne Bay, Florida.

Type not preserved.

Common all over the eastern part, at least, of the West Indian region; also known from Bermuda.

According to Clark it lives on sandy beaches, or among corals, in shallow water. It is viviparous, and its development has been studied (in preserved material) by Ludwig and Clark.

Chiridota peloria sp. nov.

Two specimens are at hand, in fragments. When intact they must have been about 25 cm. in length.

Seven pairs of digits on the tentacles, all long and slender and of almost equal size; skin thin, semitransparent, with numerous small warts.

Internal anatomy seems to be quite typical, with a low calcareous ring; a number of small Polian vesicles, and a single dorsally attached stone canal. Course of the sand-filled intestine could not be studied; muscle bands narrow, with the typical retractorlike anterior part; a few genital tubules were found, but torn loose from their base.

Deposits.— A uniformly spread layer of small curved rods, also in the warts; near the oral end, in one specimen, I found some larger warts which contained wheels. These are of variable size, but, on the whole, they are larger than most wheels in *C. rotifera*, where the layer of rods is much thinner.

Type locality.— Montego Bay, Jamaica.

Type in the Museum of Comparative Zoölogy, cat. no. 87.

Remarks.— This form is distinguished from *rotifera* by its much larger size, and the amount of spicules. The label indicates that it was found "buried in lined holes in sand, on the beach." It was taken September 1, 1910, by Professor E. A. Andrews of the Johns Hopkins University, but Dr. Clark tried in vain to find it again on his later visit to Montego Bay. It is, according to him, a quite unique mode of life for a *Chiridota*. On account of its remarkable size, Dr. Clark has suggested the name *C. peloria*.

Toxodora Verrill

Diagnosis, from Clark, 1907.— Tentacles 12. Digits numerous, 10–16. Wheels wanting, calcareous particles consisting exclusively of minute slender plates in the shape of bows or parentheses with the ends incurved.

Type species.— *Toxodora ferruginea* Verrill.

Toxodora ferruginea Verrill

Toxodora ferruginea Verrill, 1882, p. 220. Clark, 1907, p. 126.

Incompletely known; length 3 cm. or perhaps more; color reddish brown. Deposits, rods 0.06 mm. in diameter, resembling those found in *C. rotifera*.

Type locality.— Martha's Vineyard, from 140–280 m. depth.

Paratypes in the Museum of Comparative Zoölogy.

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INDEX

Synonyms are in *italics*

EXPLANATION OF PLATES

The scale of magnification (0.01 mm.) is given on each plate.

PLATE 1

PLATE 1

Holothuria cubana Ludwig

Fig. 1. Complicated large table.
Fig. 2. Small, less complicated table from near ventral appendage.
Fig. 3. Disk of juvenile table.
Fig. 4, 5. Supporting plates from feet.
Fig. 6, 7. Large buttons from dorsal side.
Fig. 8. Small button from dorsal side.

Holothuria pseudofossor spec. nov.

Fig. 9. Disk of juvenile table.
Fig. 10. Table from body wall of adult specimen.
Fig. 11–14. Buttons from body wall of adult specimen.

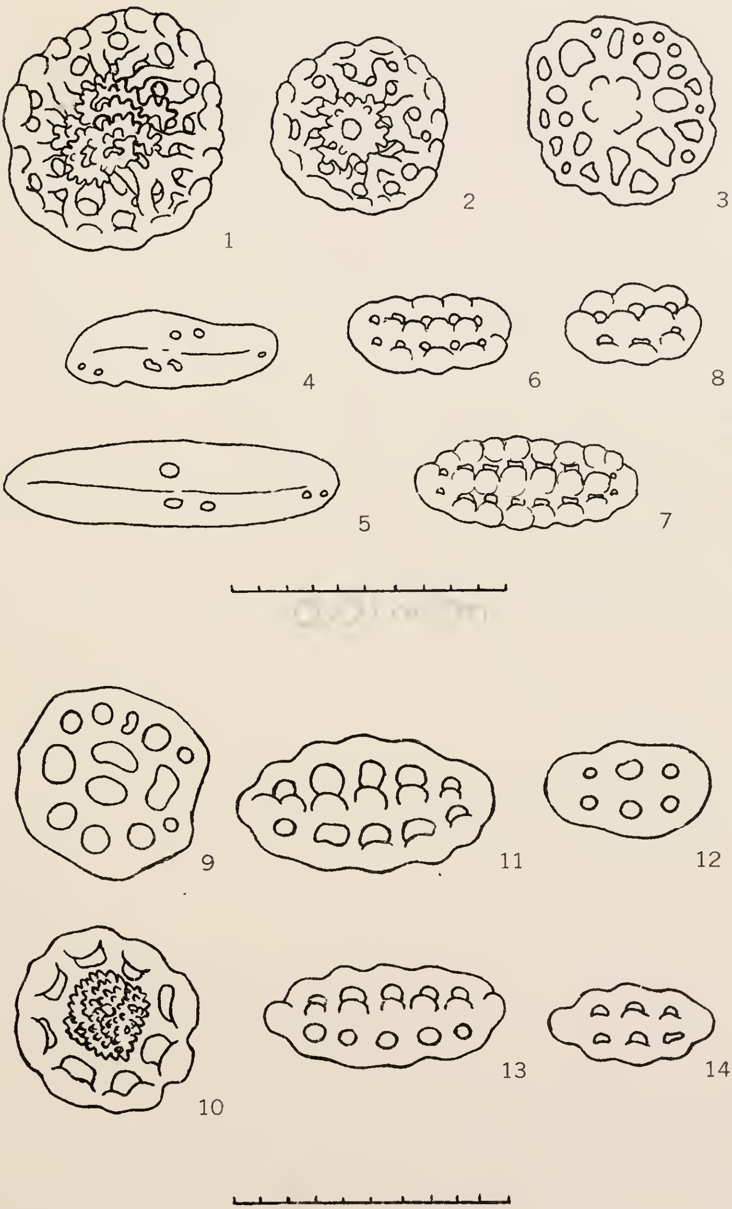
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PLATE 2

PLATE 2

Holothuria princeps Selenka

Fig. 1–4. Various stages of tables.
Fig. 5. Large table from appendage.
Fig. 6–8. Buttons.

Holothuria occidentalis Ludwig

Fig. 9–11. Tables.
Fig. 12–16. Buttons.
Fig. 17. Supporting rod from feet.

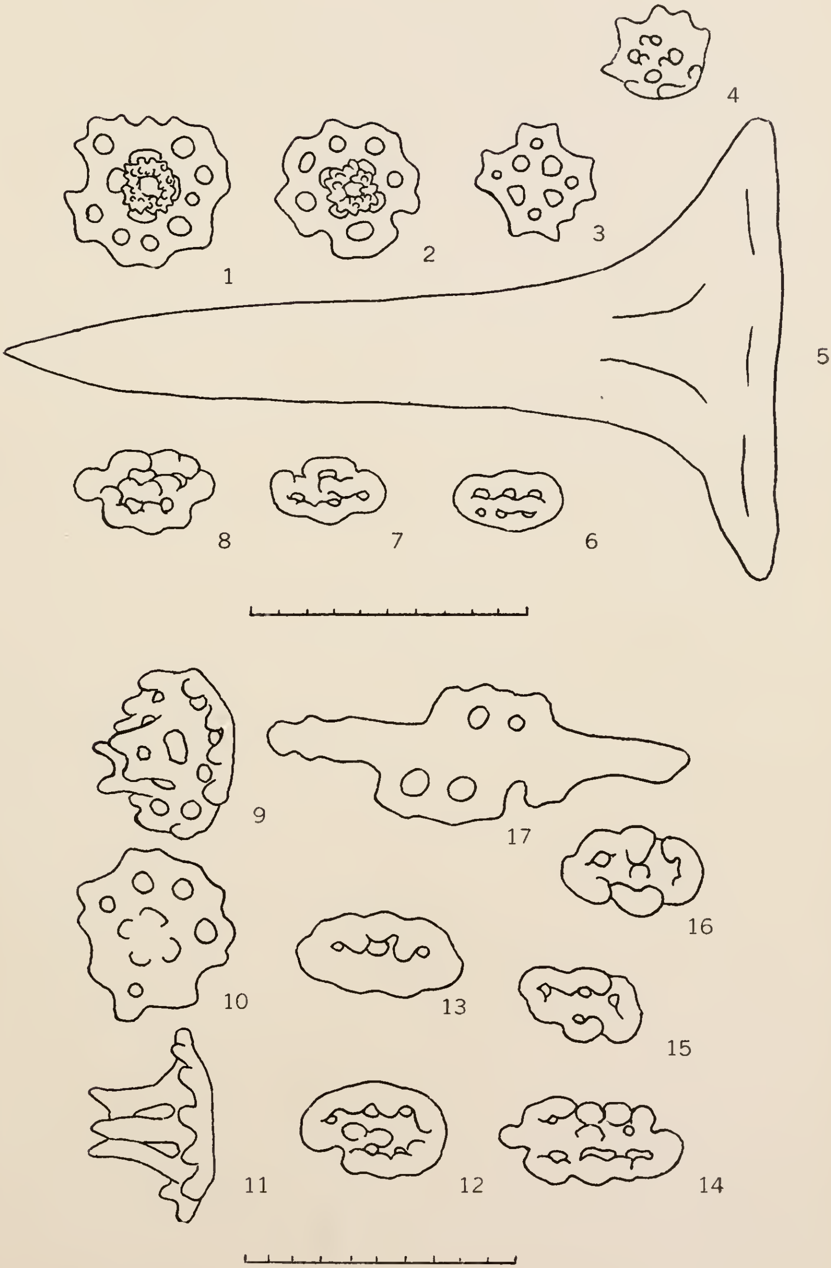
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PLATE 3

PLATE 3

Holothuria imperator spec. nov.

Fig. 1–3. Tables with reduced spire.
Fig. 4–10. Buttons.
Fig. 11. Supporting rod.

Holothuria surinamensis Ludwig

Fig. 12–14. Tables.
Fig. 15. Part of rod from body wall.
Fig. 19. Disk of table.

Holothuria languens Selenka

Fig. 16. Table.

Holothuria impatiens (Forskål)

Fig. 17. Table.
Fig. 18. Button.

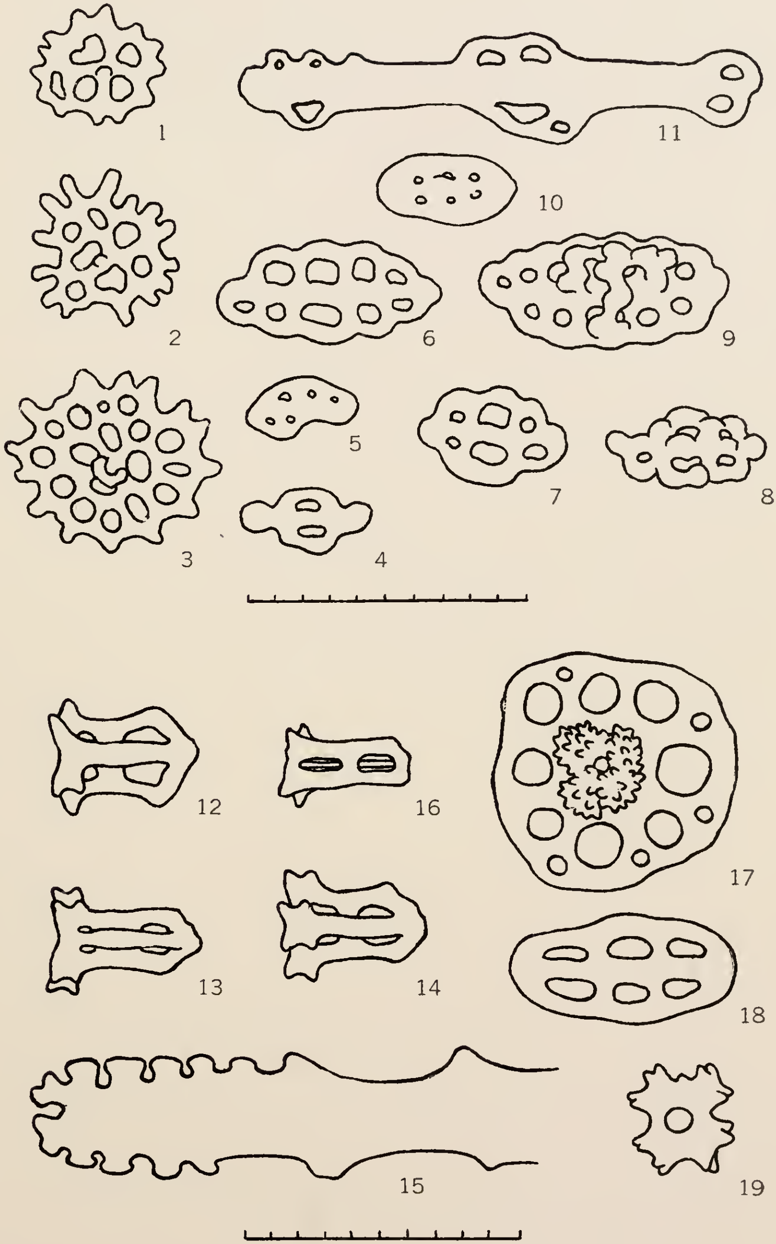
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PLATE 4

PLATE 4

Holothuria arenicola Semper

Fig. 1–4. Buttons.
Fig. 5. Table.
Fig. 6. Disk of young table.
Fig. 7–9. Supporting rods.

Holothuria glaberrima Selenka

Fig. 10–13. Rods from integument.

Holothuria parvula (Selenka)

Fig. 14. Rod from tentacle.
Fig. 15. Juvenile buttons.
Fig. 16, 17. Juvenile tables.
Fig. 18, 19. Supporting plates and rods from feet.
Fig. 20. Table from adult.
Fig. 21, 22. Buttons from adult.

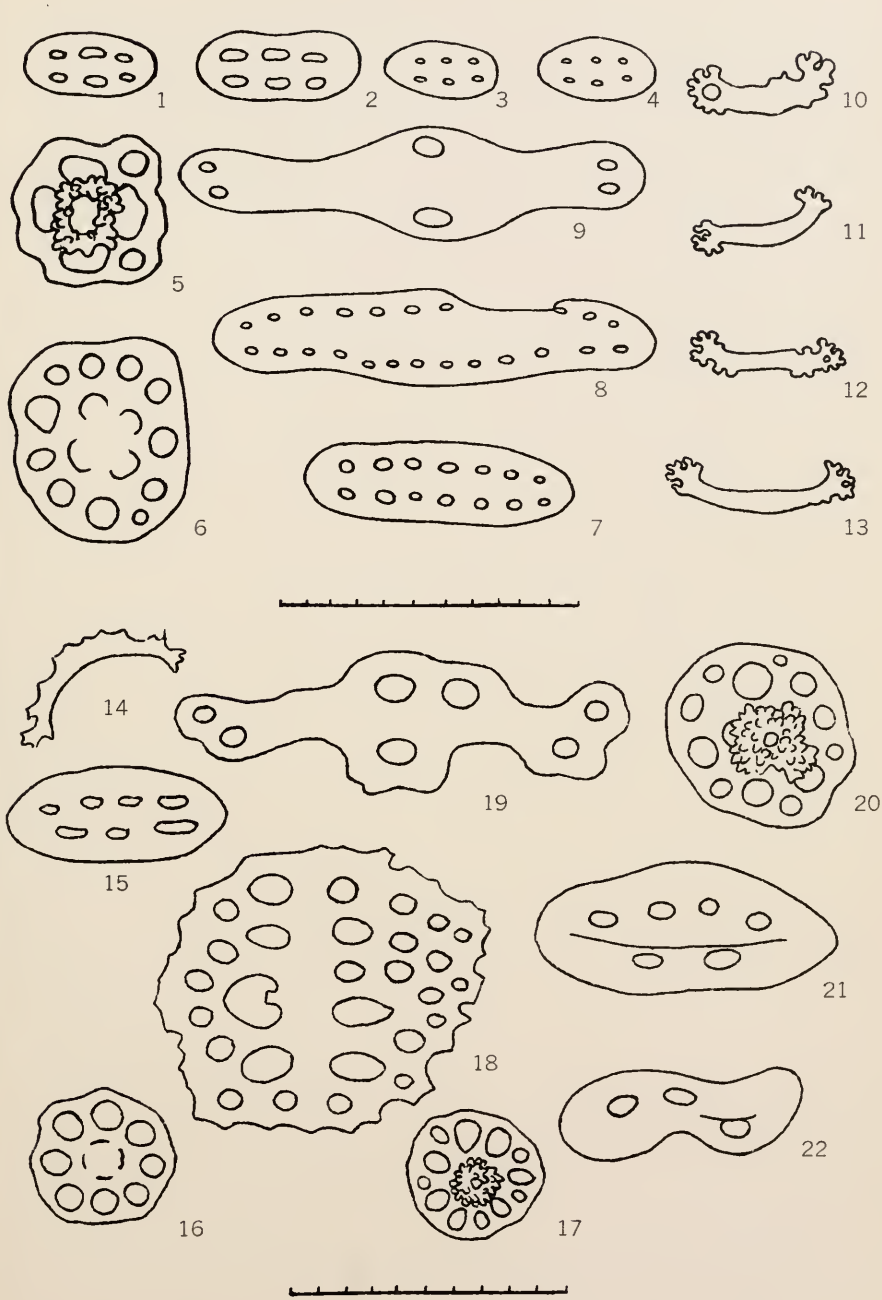
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PLATE 5

PLATE 5

Holothuria grisea Selenka

Fig. 1. Supporting rod.
Fig. 2. Plate from integument.
Fig. 3. Disk of table.
Fig. 4. Table, lateral view.

Holothuria floridana Pourtalès

Fig. 5. Table.
Fig. 6–9. Rosettes.

Holothuria atra (Jaeger)

Fig. 10–14. Rosettes.

Holothuria mexicana Ludwig

Fig. 15–20. Biscuit-shaped plates.

Actinopyga agassizi (Selenka)

Fig. 21–29. Plates and rods from body wall.

Stichopus badionotus Selenka

Fig. 30, 31. Tables from adult.
Fig. 32, 33. Disk of table from adult.
Fig. 34, 35. Tables from young specimens.
Fig. 36. Lateral view of table from young specimen.

Stichopus macroparenthesis Clark

Fig. 37. Exceptionally small table.
Fig. 38. Table from young specimen.
Fig. 39, 40. Tables from adult specimen.
Fig. 41, 42. Lateral view of tables.
Fig. 43. C-shaped body.

Astichopus multifidus (Sluiter)

Fig. 44. C-shaped bodies.
Fig. 45. Grains.
Fig. 46, 47. Rods from tentacles.

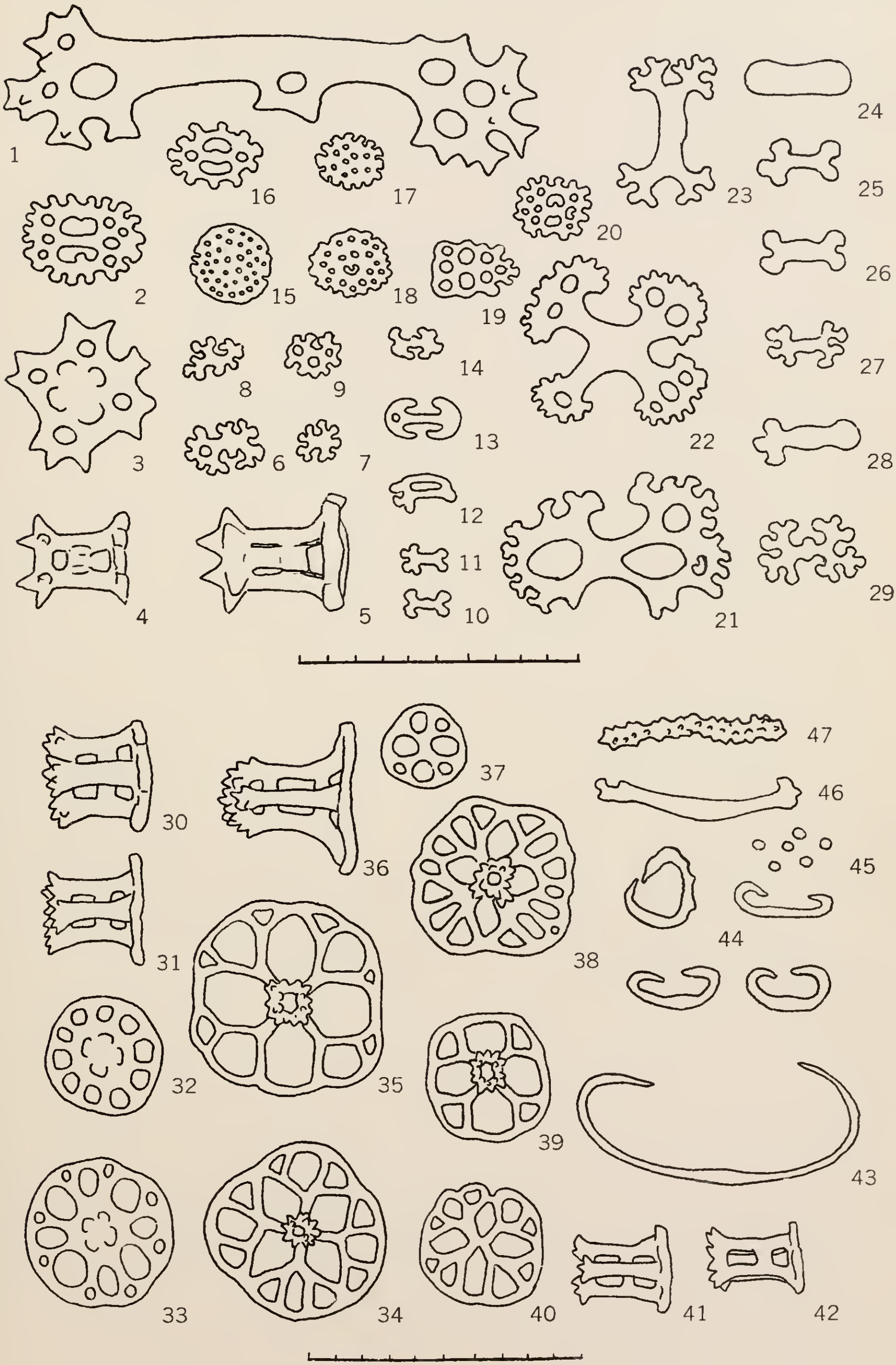
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PLATE 6

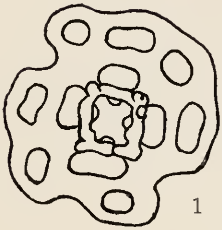
PLATE 6

Mesothuria verrilli (Théel)

Fig. 1–3. Disk of common type.
Fig. 4. Lateral view of table of common type.
Fig. 5. Lateral view of table of rare type.
Fig. 6. Disk of table of rare type.
Fig. 7. Lateral view of table from young specimen.
Fig. 8. Disk of table from young specimen.

Mesothuria intestinalis (Asc. and Rathke)

Fig. 9. Table seen from above.
Fig. 10. Disk of table.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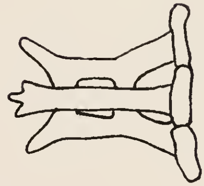
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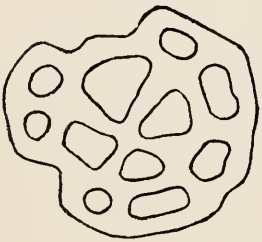
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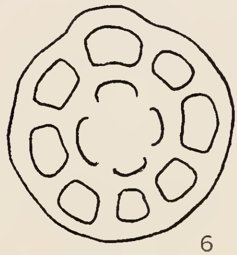
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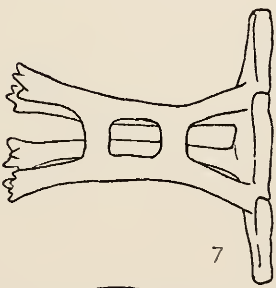
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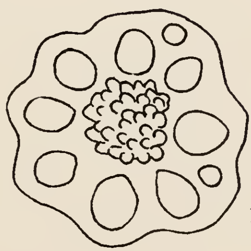
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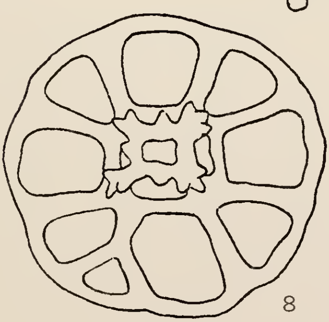
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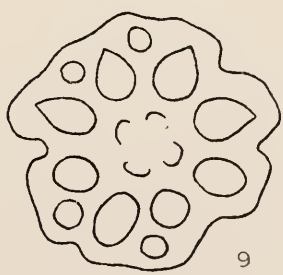
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PLATE 7

PLATE 7

Mesothuria gargantua spec. nov.

Fig. 1. Typical table of the large kind.

Mesothuria marrocana Perrier

Fig. 2–5. Tables from body wall.

Figs. 6, 7. Lateral view of tables from appendages.

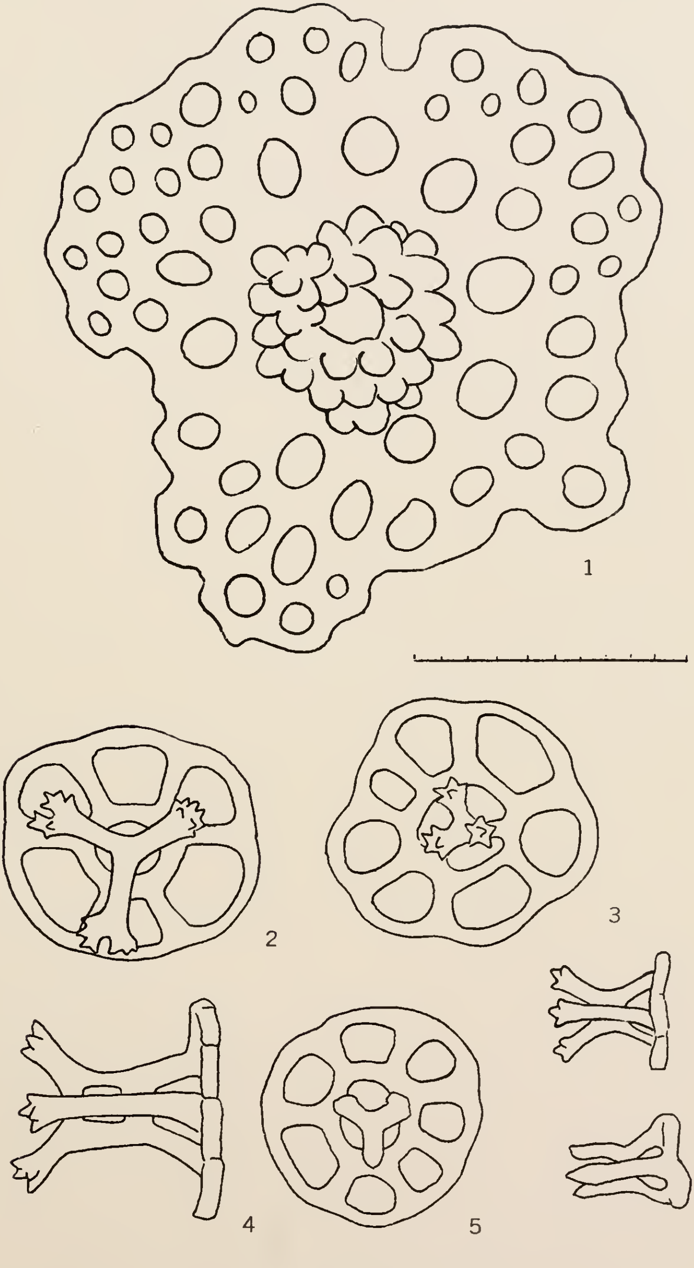

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PLATE 8

PLATE 8

Mesothuria rugosa Hérouard

Fig. 1. Lateral view of table.
Fig. 2. Disk of table.
Fig. 3–5. Lateral view of tables from appendages.
Fig. 6. End plate.

Zygothuria sp.

Fig. 7. Disk of table.

Zygothuria lactea (Théel)

Fig. 8. Disk of table.
Fig. 9. Lateral view of table with undivided spire.

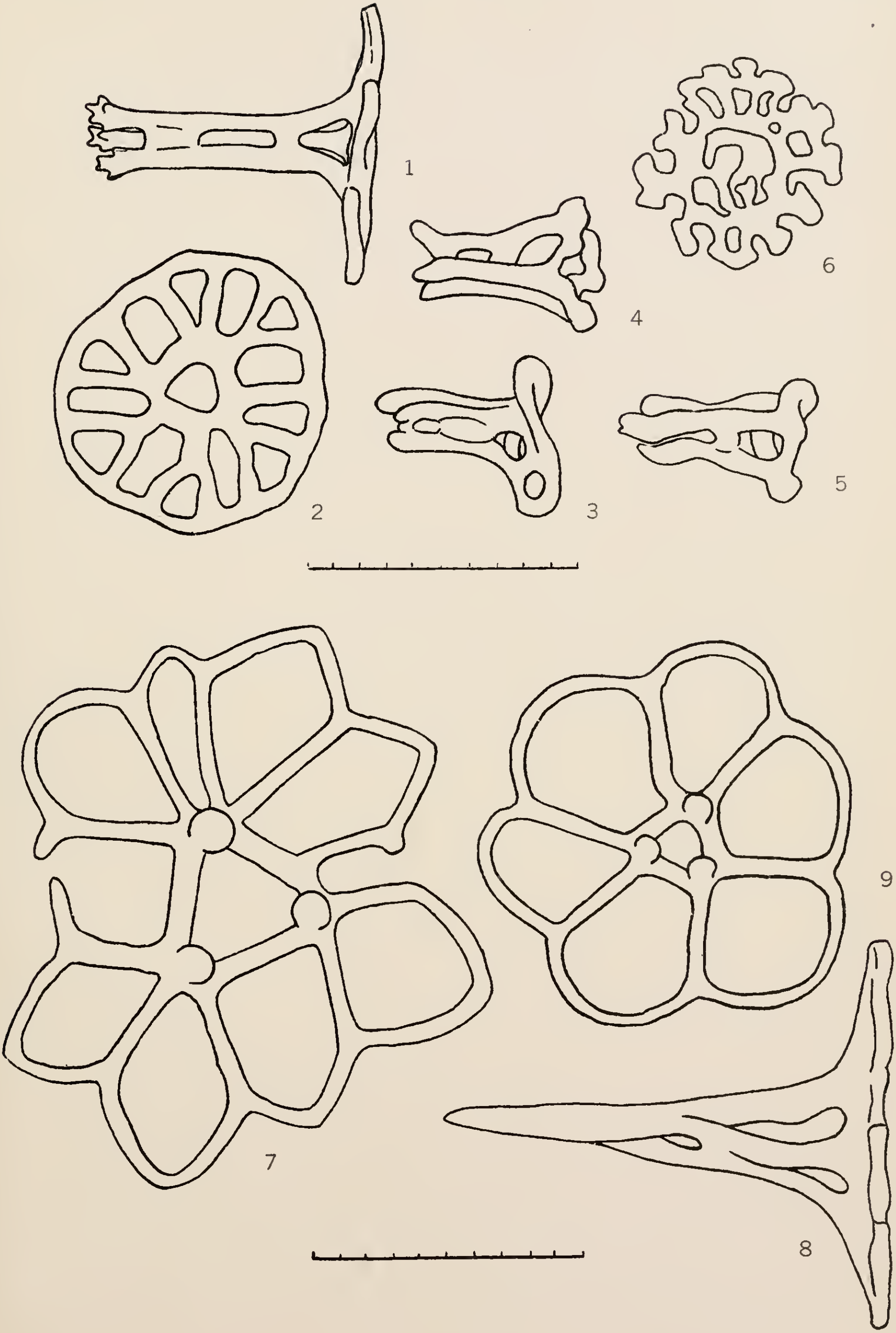
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PLATE 9

PLATE 9

Bathyplotes natans (Sars)

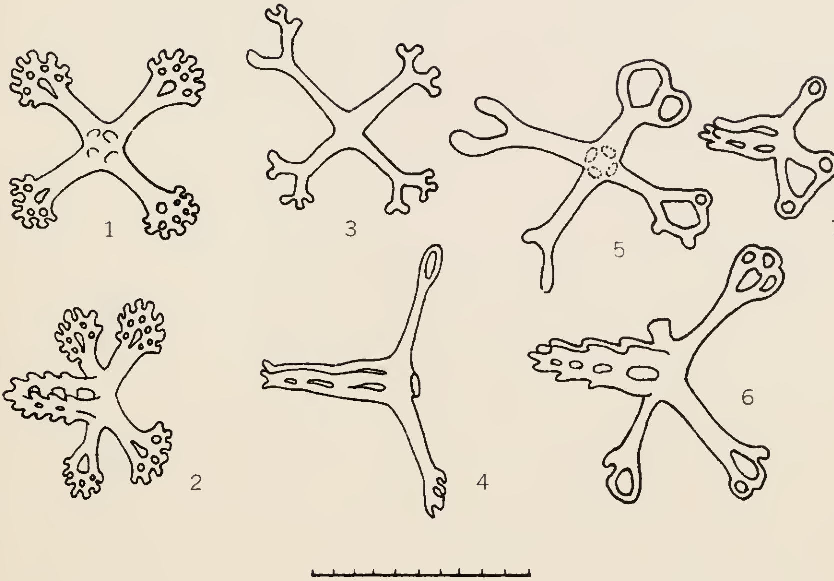
Fig. 1, 2. Cross-shaped tables.
Fig. 9. Total figure (about half size).

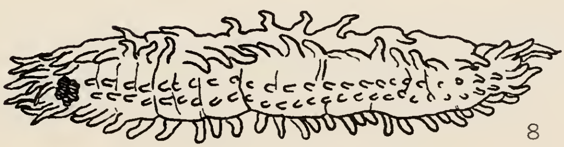
Bathyplotes pourtalesi Théel

Fig. 3, 4. Deposits from typical form.
Figs. 5–7. Deposits from untypical form (no fungiform papillae).

Amphigymnas bahamensis spec. nov.

Fig. 8. Total figure (about half size).





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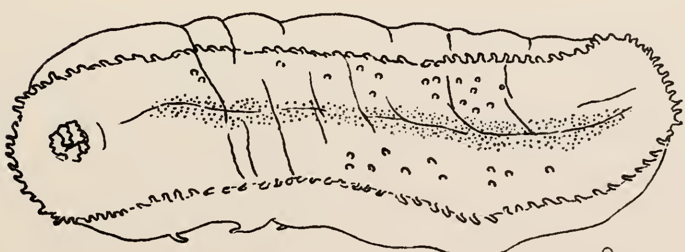

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PLATE 10

PLATE 10

Amphigymnas bahamensis nov. sp.

Fig. 1, 2. Supporting rods.
Fig. 3. Small table from appendage.
Figs. 4, 5. Plates (tables with reduced spire).
Fig. 6. Small table with well-developed three-pillared spire.

Deima blakei Théel

Fig. 7. Plate from body wall.
Fig. 8. Rod from layer outside the plates.
Fig. 9, 10. Plates from near tentacles.
Fig. 11. Rod from appendage.

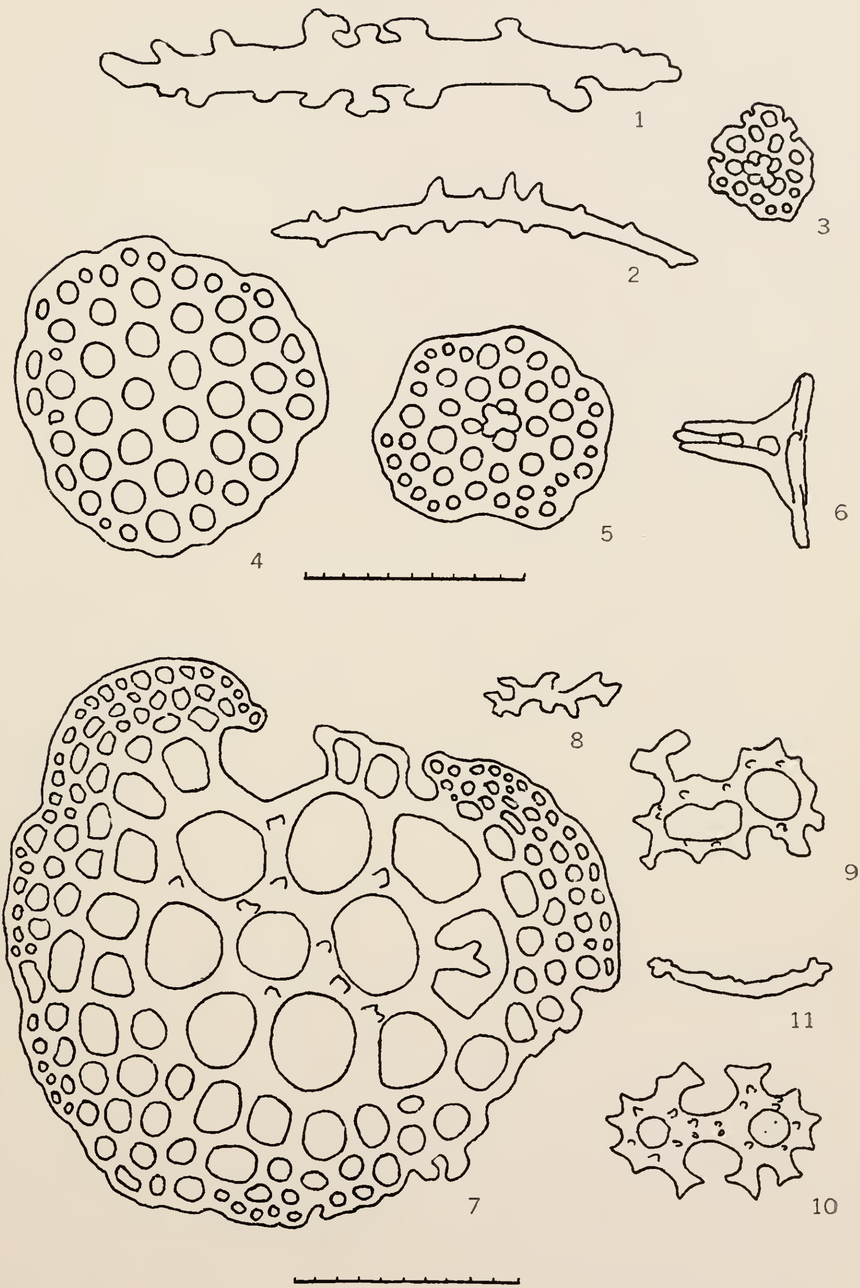
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PLATE 11

PLATE 11

Deima blakei Théel

Fig. 1–3. Deposits from wall of genital organs.

Orphnurgus asper Théel

Figs. 4–8. Rods from body wall.

Cucumaria calcigera Stimpson

Figs. 9, 10. Tables.
Figs. 11, 12. Plates.

Cucumaria pulcherrima (Ayres)

Figs. 13, 14. Tables with reduced spire.
Fig. 15. Supporting rod (elongate table).
Fig. 16. Plate near end of appendage.

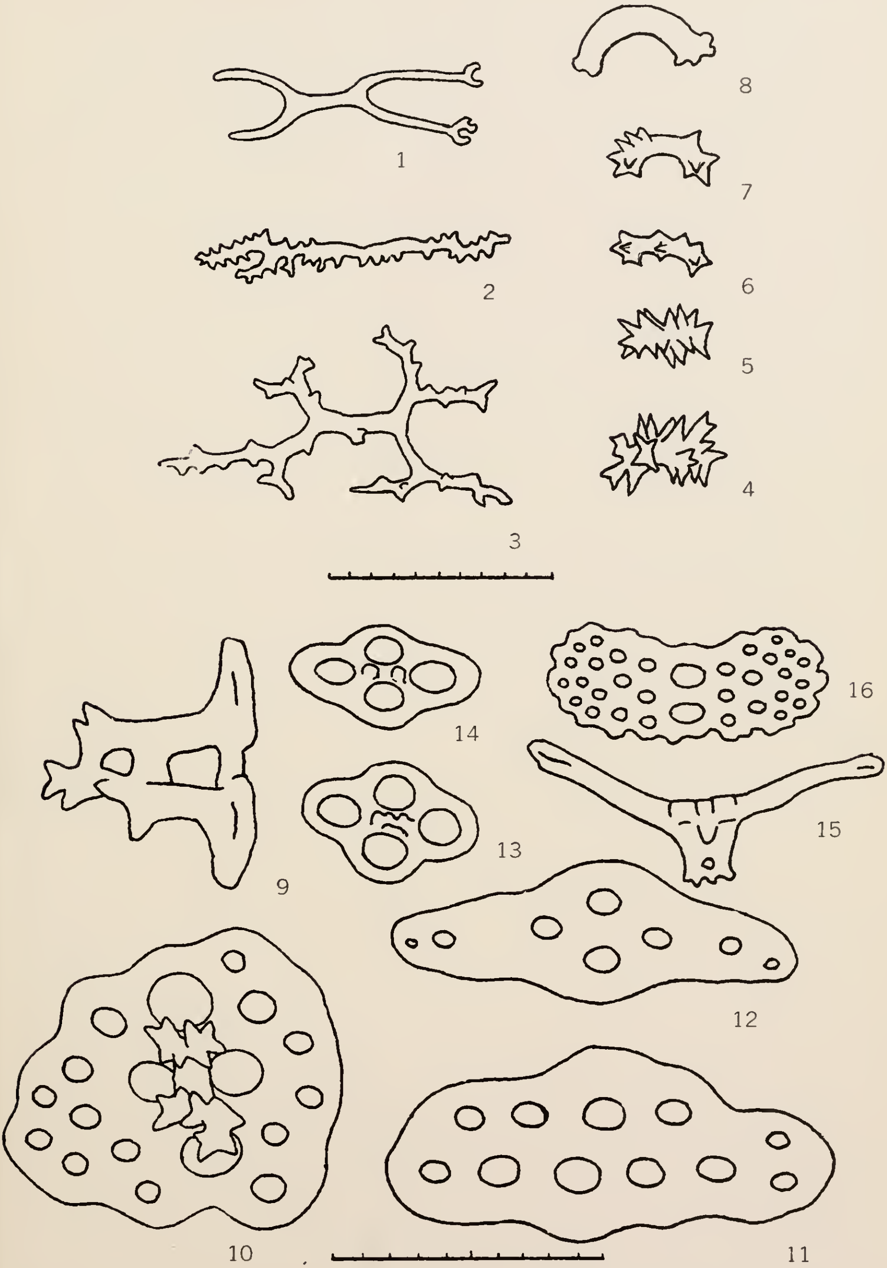
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PLATE 12

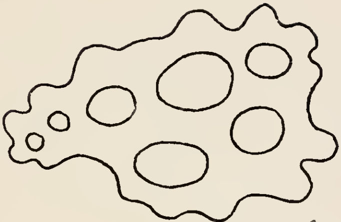
PLATE 12

Cucumaria nina spec. nov.

Fig. 1–3. Plates.
Figs. 4, 5. Flat baskets.

Cucumaria frondosa (Gunnerus)

Figs. 6–9. Various stages of plates.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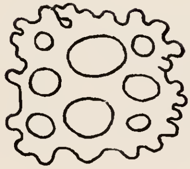
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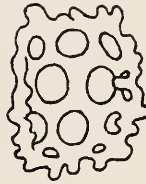
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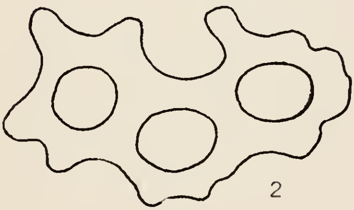
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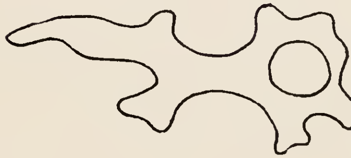
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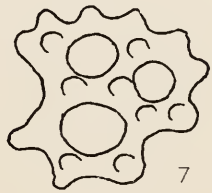
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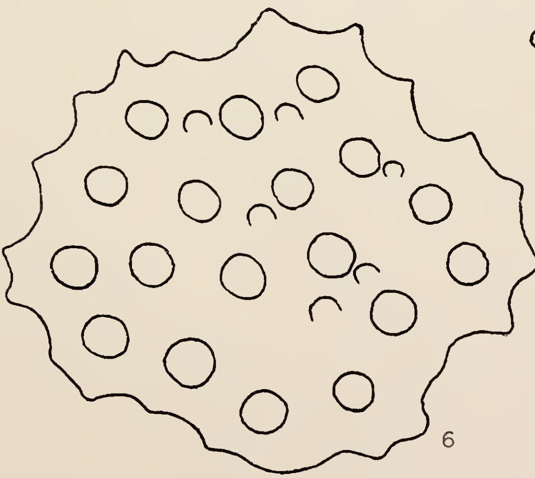
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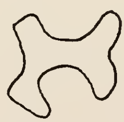
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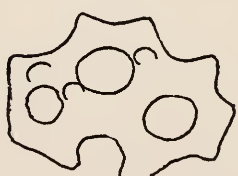
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PLATE 13

PLATE **13**

Cucumaria parassimilis spec. nov.

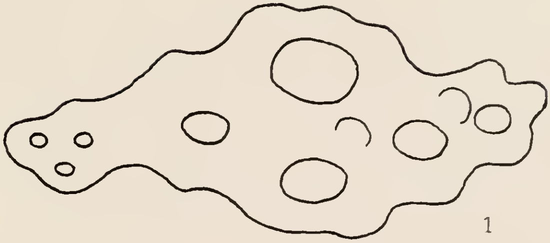
Figs. 1, 2. Plates from body wall.

Thyone scabra Verrill

Fig. 3. Table.
Fig. 4. Supporting table.

Thyone briareus (Lesueur)

Fig. 5. Supporting table.
Fig. 6. Table from body wall.
Fig. 7. Table from introvert.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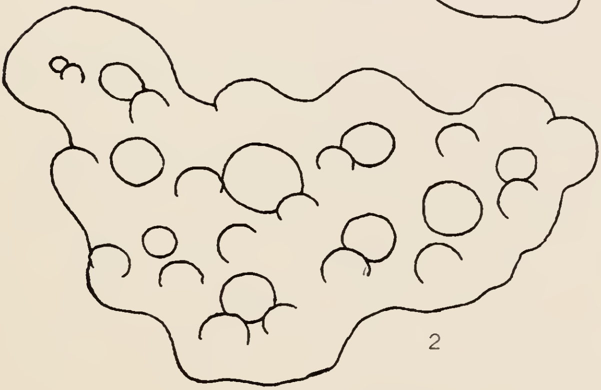
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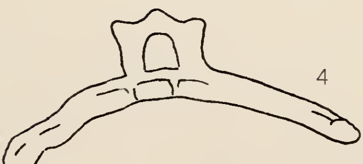
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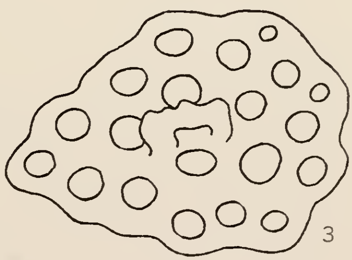
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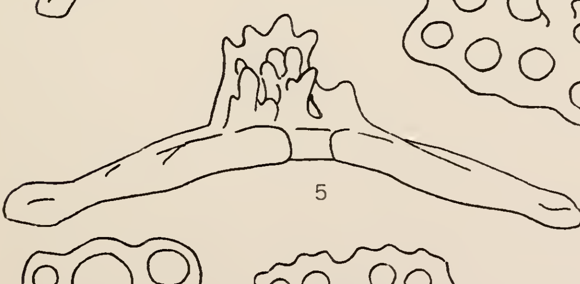
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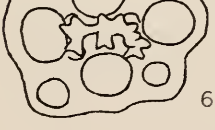
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PLATE **14**

PLATE 14

Thyone fusus (O.F.M.) ?

Figs. 1–4. Table from body wall.
Fig. 5. Table from introvert.

Thyone pseudofusus spec. nov.

Figs. 6–8. Tables from body wall.
Fig. 9. Supporting rod as table, from appendage.

Thyone belli Ludwig

Fig. 10. Supporting rod as table.
Figs. 11, 12. Buttons.
Fig. 13. Rosette from introvert.

Thyone micropunctata Sluiter

Fig. 14. Large plate from inner layer of deposits.
Fig. 15. Small button with spinous handle.
Fig. 16. X-shaped stage of button.
Fig. 17. Normal button.
Fig. 18. Supporting rod as table.

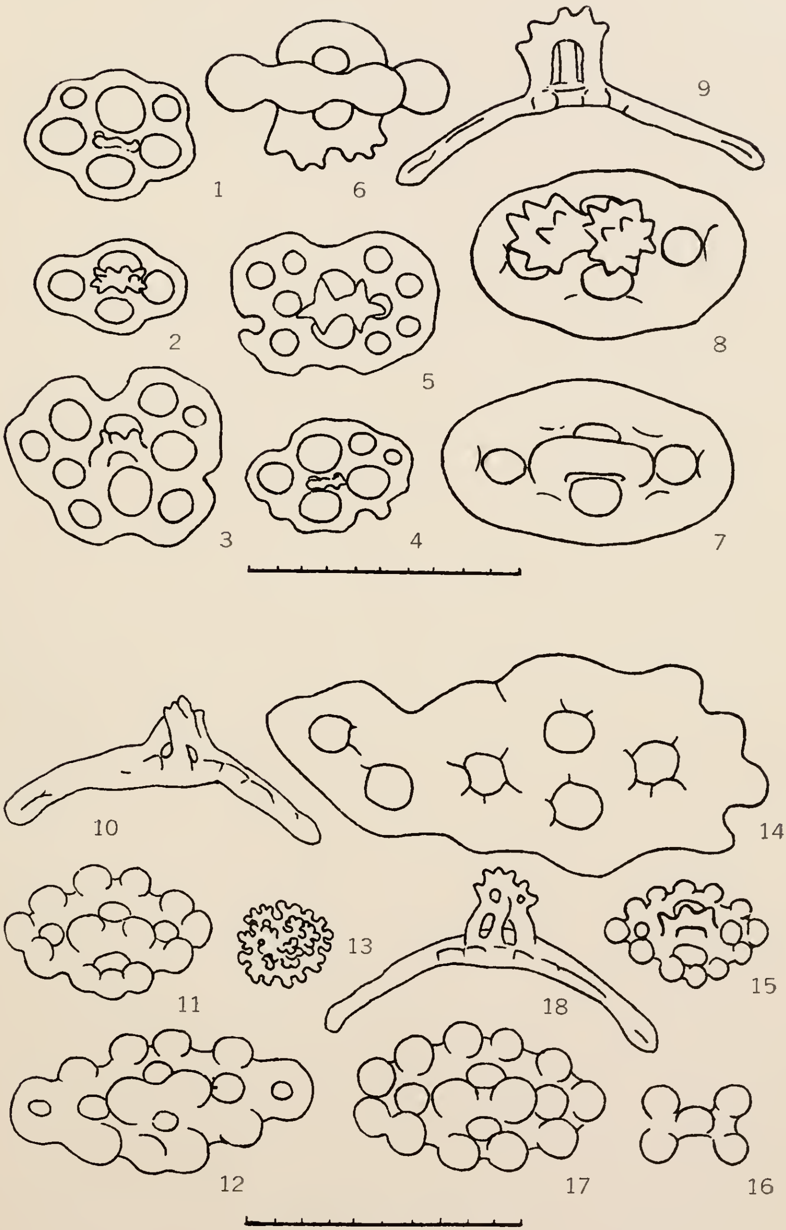
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PLATE 15

PLATE 15

Thyone cognita Lampert

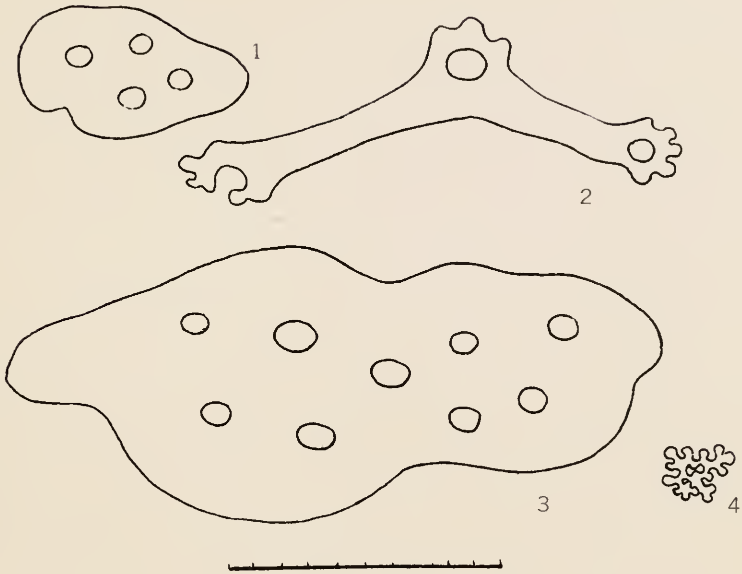
Figs. 1, 2. Plates
Fig. 3. Supporting rod.
Fig. 4. Rosette from introvert.

Thyone unisemita (Stimpson)

Fig. 5. Plate from introvert.
Figs. 6–8. Buttons from integument.
Fig. 9. Incomplete button from integument.
Fig. 10. Supporting rod.

Thyone solida spec. nov.

Figs. 11, 12. Buttons from integument.
Figs. 13, 14. Rosettes from introvert.
Figs. 15, 16. Baskets from integument.
Fig. 17. Simple plate from integument.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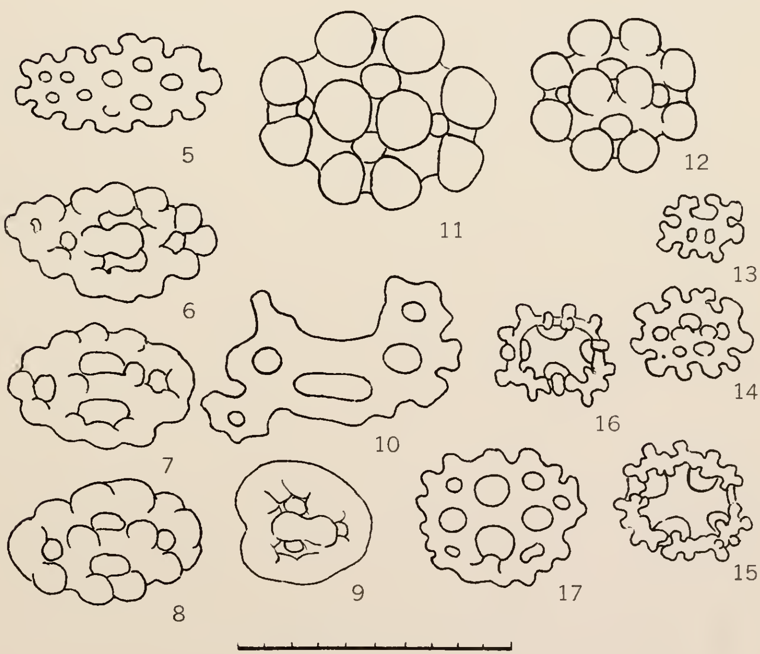
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PLATE 16

PLATE 16

Thyone solida spec. nov.

Figs. 1, 2. Supporting rods.

Thyone suspecta Ludwig

Fig. 3. Basket.
Fig. 4. Button.

Thyone surinamensis Semper

Figs. 5, 6. Buttons.
Fig. 7. Basket.
Fig. 8. Supporting rod.

Thyone pervicax Théel

Figs. 9, 10. Buttons from body wall.
Figs. 11–12. Baskets.

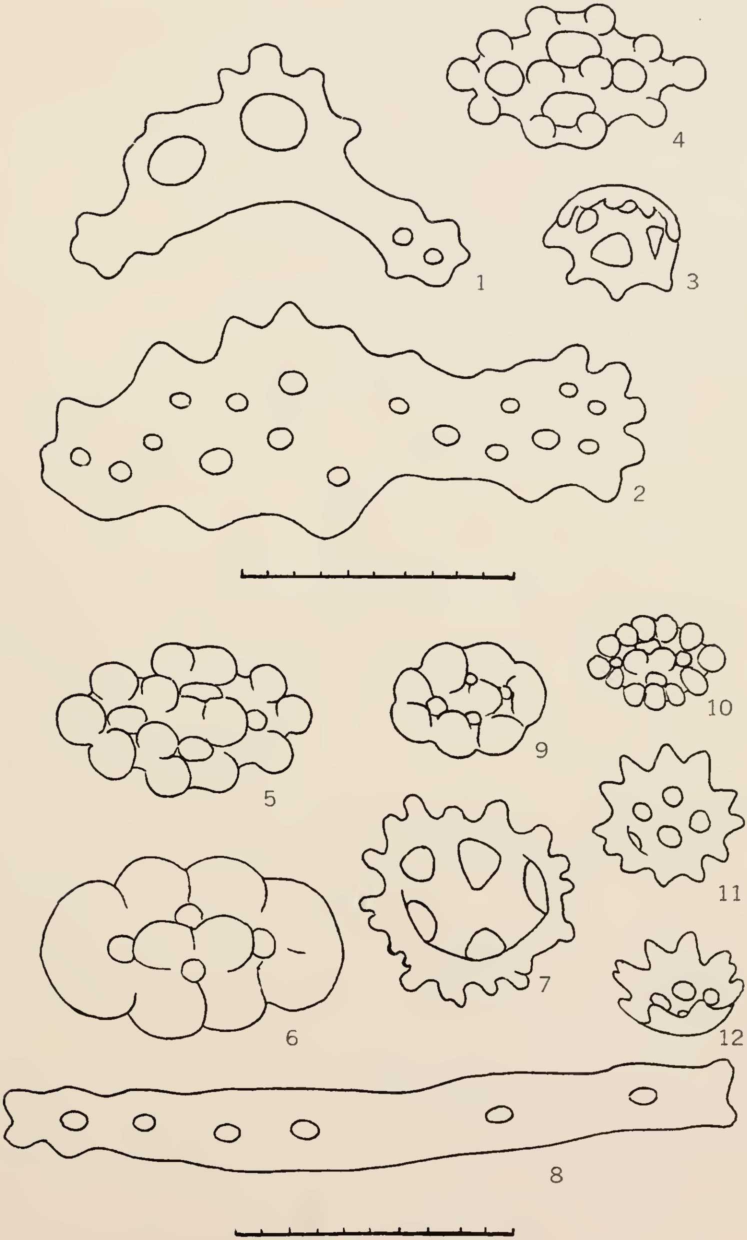
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PLATE **17**

PLATE 17

Thyone gemmata Pourtalès

Figs. 1, 2. Buttons.
Fig. 3. Basket.

Thyone sabanillensis spec. nov.

Figs. 4–6. Buttons.
Fig. 7. Plate.
Figs. 8, 9. Baskets.

Phyllophorus seguroensis spec. nov.

Fig. 10. Table from introvert.
Figs. 11, 12. Tables from body wall.
Fig. 13. Rosette from introvert.

Phyllophorus conchilegum Pourtalès

Figs. 14, 15. Tables.

Phyllophorus communis Forbes

Figs. 16, 17. Tables from introvert.

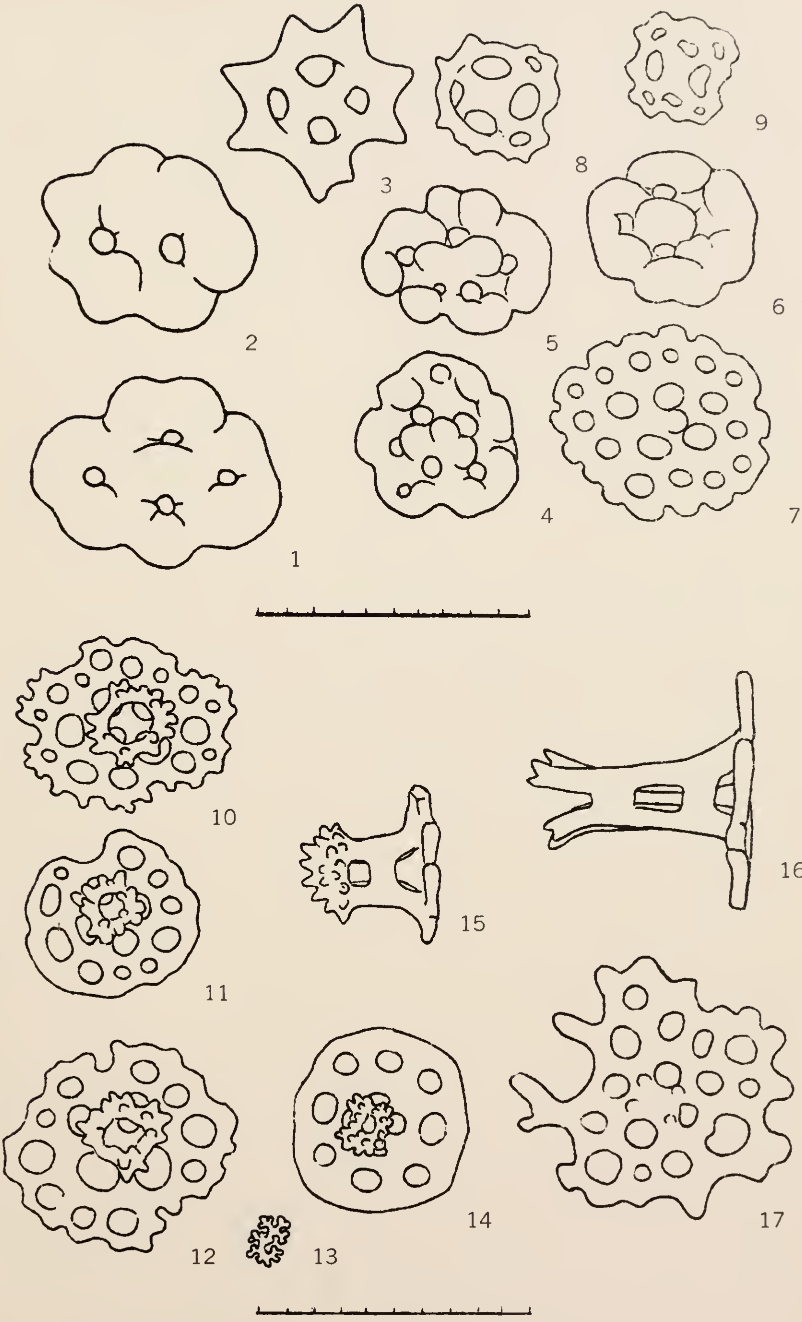
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PLATE 18

PLATE 18

Phyllophorus occidentalis Ludwig

Figs. 1, 2. Tables.

Phyllophorus destichadus spec. nov.

Fig. 3. Table.

Phyllophorus trita (Sluiter)

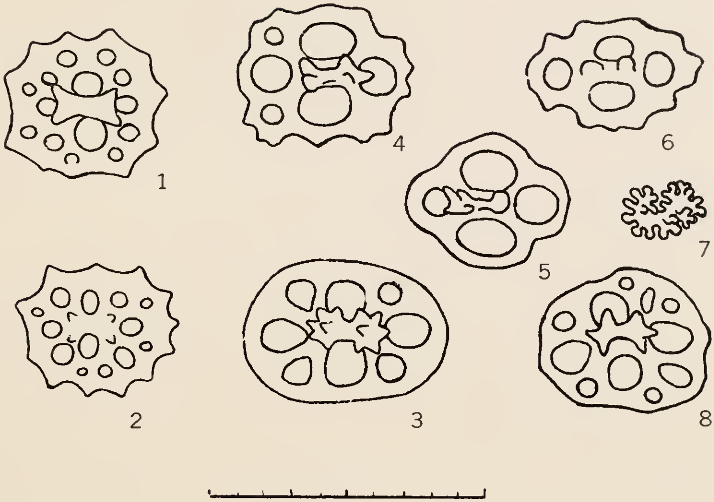
Figs. 4–6. Tables.
Fig. 7. Rosette from introvert.
Fig. 8. Table from introvert.

Echinocucumis hispida (Barrett)

Fig. 9. Medium-sized plate with eccentric spire.

Echinocucumis hispida var. atypica Théel

Fig. 10. Solid spire from large plate.
Fig. 11. Medium-sized plate with rudimentary spire.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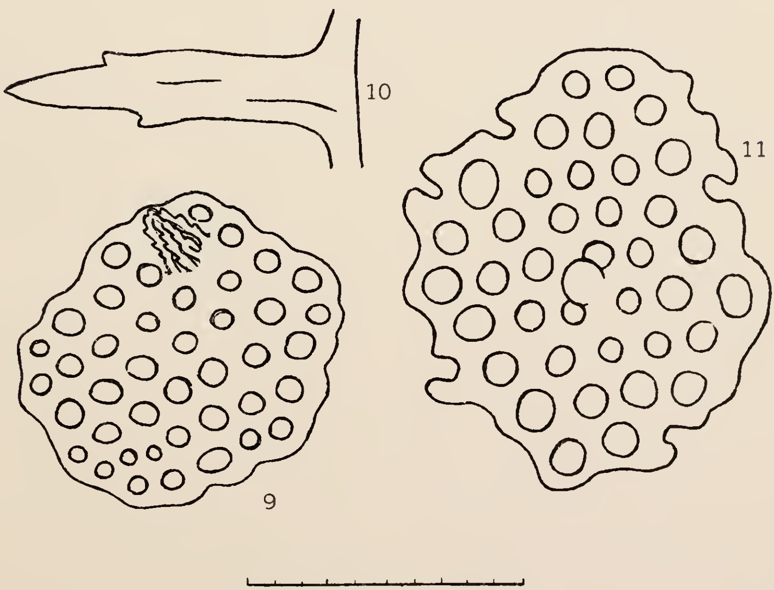
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PLATE 19

PLATE 19

Sphaerothuria asperrima (Théel)

Fig. 1. Simple plate from young specimen.
Fig. 2. Plate from tentacle.

Sphaerothuria talismani (Perrier)

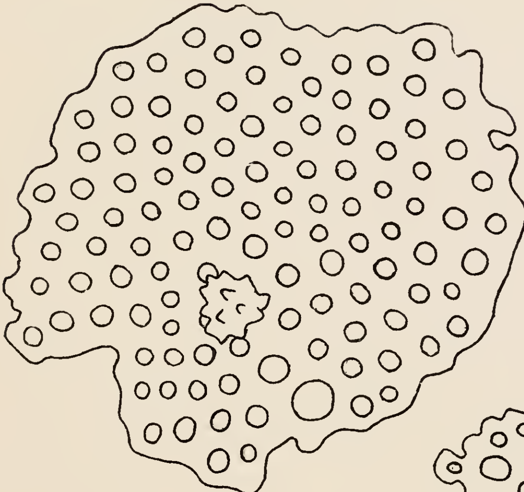
Fig. 3. Rod from tentacle.

Sphaerothuria bitentaculata Ludwig

Figs. 4, 5. Plates from tentacle.

Psolus complicatus spec. nov.

Figs. 6–8. Plates from sole.
Fig. 9. Basket from dorsal side.



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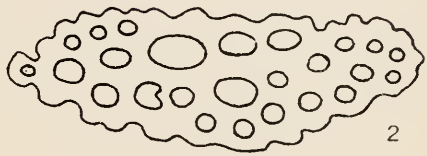

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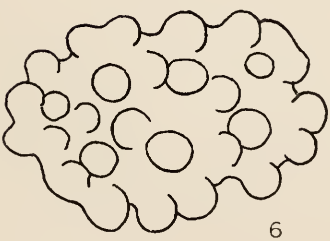

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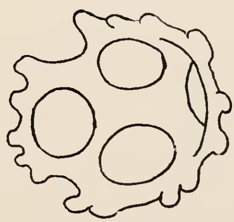

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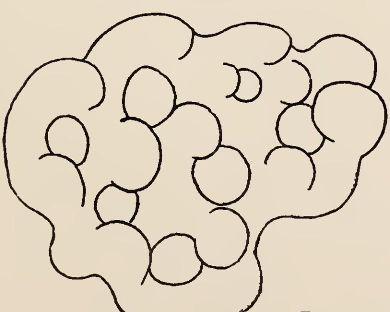

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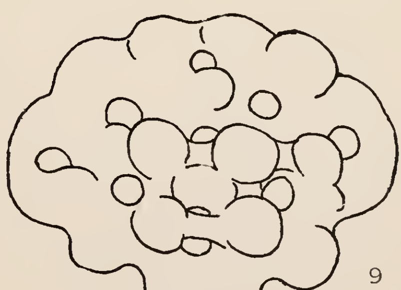

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PLATE **20**

PLATE 20

Psolus operculatus (Pourtalès)

Figs. 1, 2. Plates from sole.

Psolus tuberculosus Théel

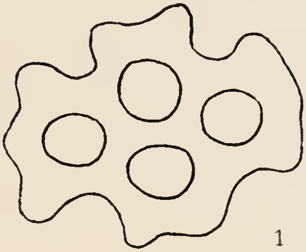
Fig. 3. Plate from sole.

Psolus tuberculosus var. *destituta*

Fig. 4. Plate from sole.

Psolus pourtalesi Théel

Figs. 5–7. Plates from sole.



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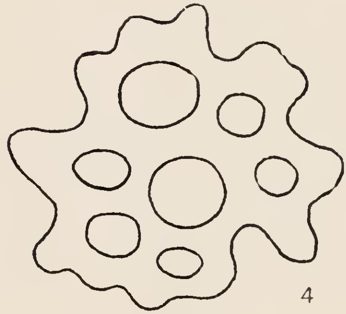

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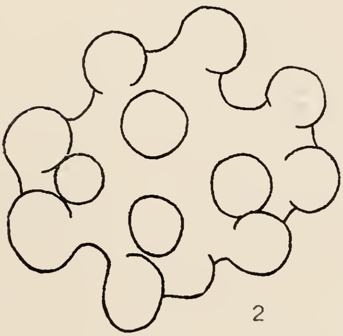

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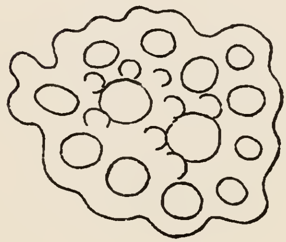

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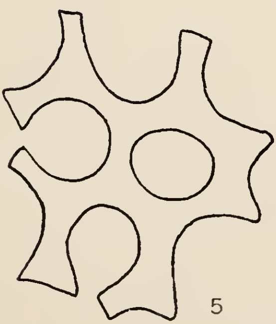

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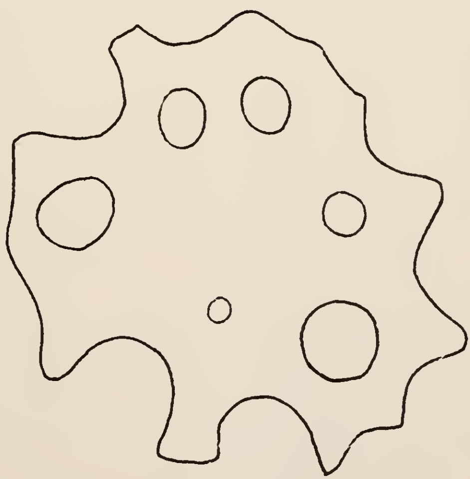

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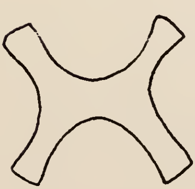

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PLATE 21

PLATE 21

Thyonepsolus braziliensis (Théel)

Figs. 1, 2. Plates from sole.
Fig. 3. Towerlike deposit from dorsal side (low magnification).
Figs. 4, 5. Hour glass shaped deposits from dorsal side.
Fig. 6. Plate from dorsal side.

Pseudocolochirus mysticus spec. nov.

Figs. 7, 8. Buttons.
Fig. 9. Supporting rod.

Pentacta pygmaeus (Théel)

Figs. 10, 11. Baskets.
Figs. 12, 13. Buttons.
Fig. 14. Supporting rod.
Figs. 15, 16. Rosettes from introvert.

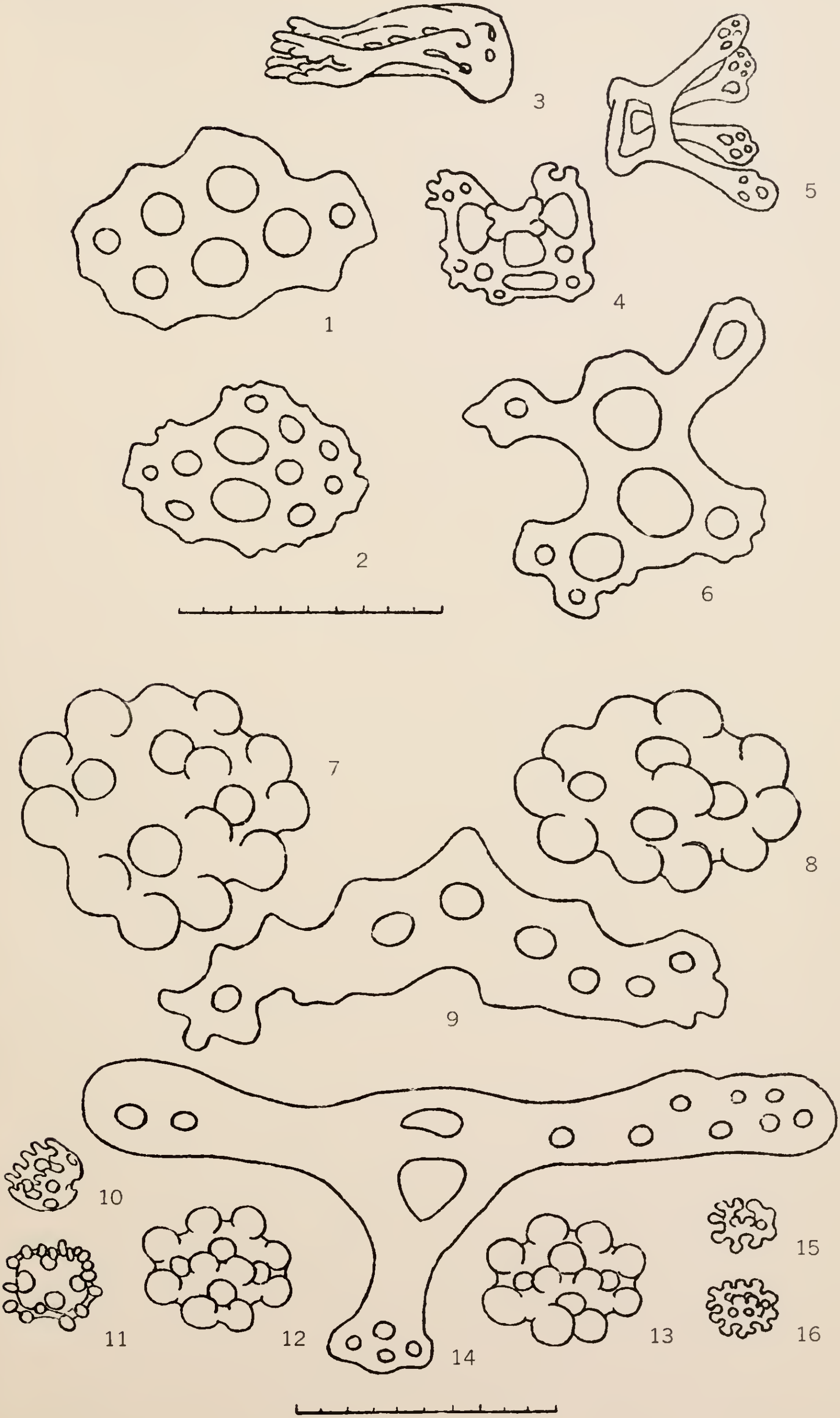
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PLATE **22**

PLATE 22

Molpadia oolitica Verrill (M.C.Z. Cat. no. 138)

Figs. 1–3. Tables with more or less preserved disk.

Molpadia musculus Risso (young)

Figs. 4, 5. Tables.
Fig. 6. Part of racket-shaped deposit.
Figs. 7, 8. Fusiform tables from body wall (large specimens).
Fig. 9. Fusiform rods from tail.

Molpadia parva (Théel) (M.C.Z. Cat. no. 135)

Figs. 10–12. Disk of tables.
Fig. 13. Lateral view of table.

Molpadia oolitica Verrill (young)
[Théel's antarcticum]

Figs. 14–18. Tables from body wall.

Molpadia blakei (Théel)

Fig. 19. Spire of table with anchor-like hooks.
Figs. 20, 21. Tables from tail.
Figs. 22, 23. Tables from body wall.

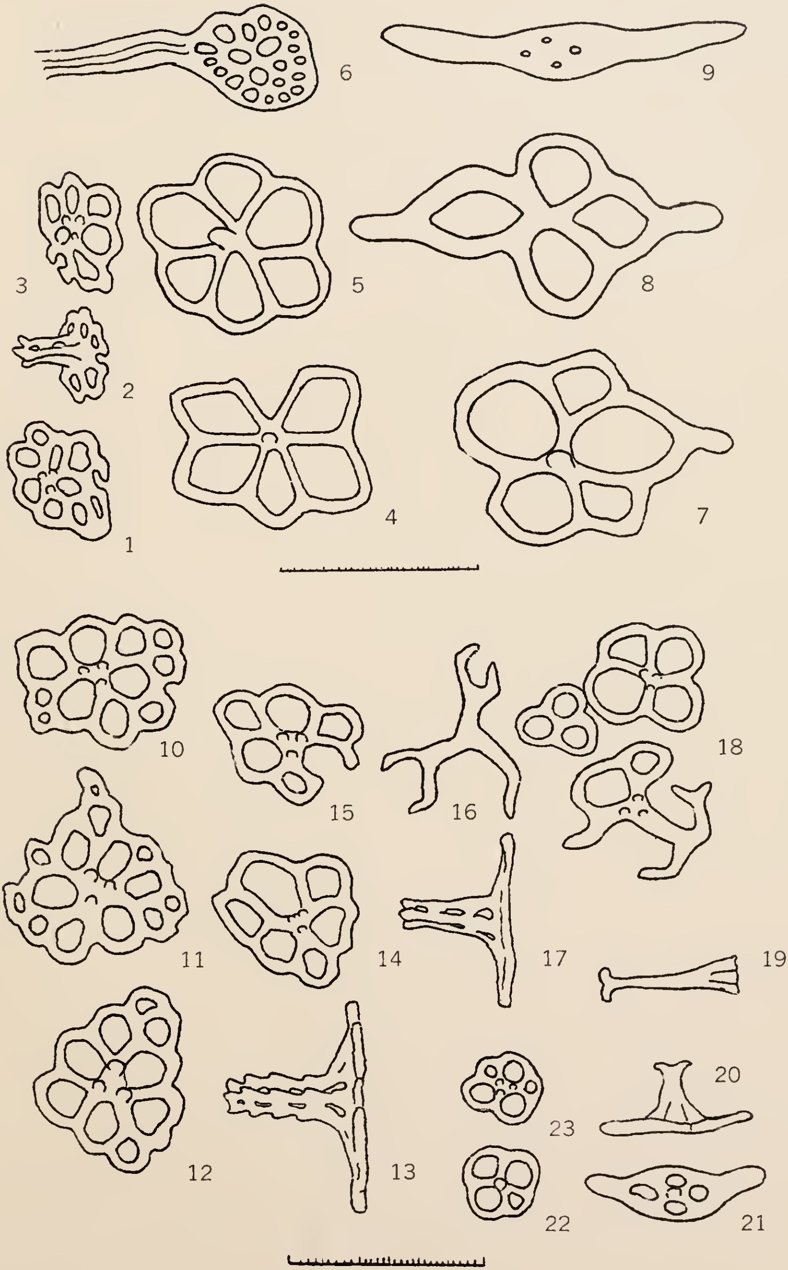
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PLATE 23

PLATE 23

Molpadia agassizi (Théel)

Fig. 1. Large typical plate.
Fig. 2. Small plate with rudiment of spire.
Fig. 3. Fusiform rod from tail.

Molpadia musculus (Risso)

Fig. 4. Large plate with numerous holes from large specimen (loricata stage).

Molpadia musculus (Risso)

Figs. 5–7. Typical fusiform bodies from body wall with low number of holes.

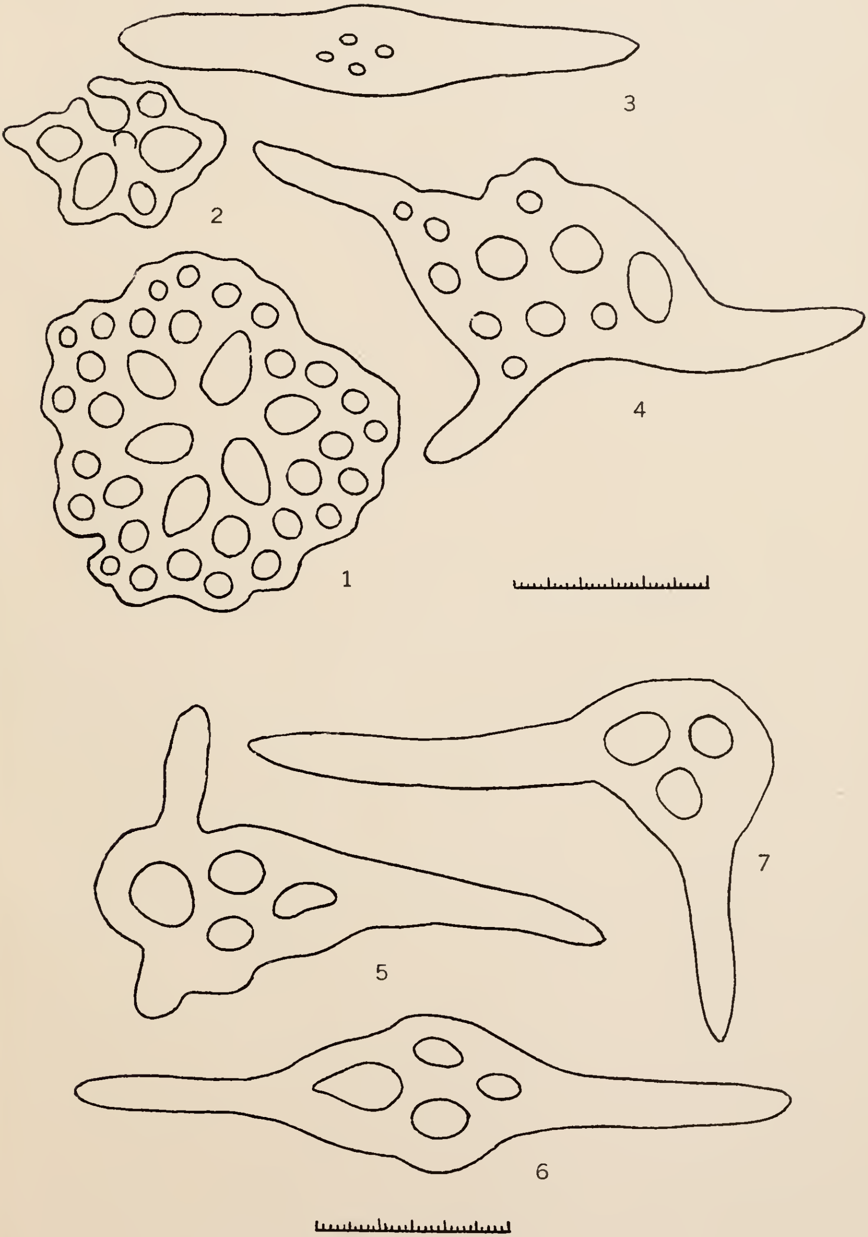
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PLATE **24**

PLATE 24

Caudina albicans (Théel)

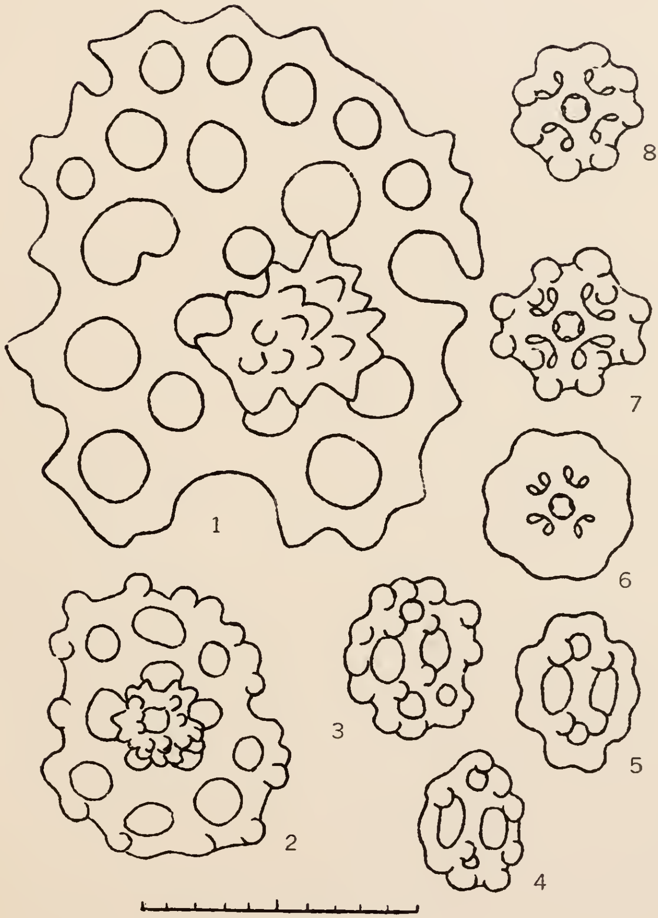
Fig. 1. Table.

Caudina arenata Gould

Fig. 2. Table.
Figs. 3–5. Buttons.

Caudina obesacauda Clark

Fig. 6–8. Four-spoked buttons.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Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. LXXI. No. 4

TYPE SPECIMENS OF MAMMALS IN THE MUSEUM OF COMPARATIVE ZOÖLOGY

By Glover M. Allen

CAMBRIDGE, MASS., U. S. A.:
PRINTED FOR THE MUSEUM
January, 1931

No. 4.— *Type Specimens of Mammals in the Museum of Comparative Zoölogy*

By Glover M. Allen

The following list includes all specimens in the collection of fossil and recent mammals on which systematic names have been based, whether in whole (holotypes) or in part (cotypes), and whether such names are of valid forms (eutypes) or whether they are names currently regarded as synonyms (metatypes). It is intended to be complete to the close of the year 1930.

The greater part of the types are contained in the E. A. and O. Bangs Collection, which was acquired in 1901. Of fossil species (indicated by a dagger (†)), there are sundry types received from the J. D. Whitney Collection (mainly from California), as well as a few from the Bronn, Campiche, Duval and Eser Collections from Europe; also most of the types described by W. B. Scott and H. F. Osborn from material collected by S. Garman and others in the White River formation of Dakota in the early days of its exploitation. A few specimens of recent mammals received many years ago through exchange with the Smithsonian Institution, at a time when "duplicates" were freely disposed of, prove to be cotypes or even actual types, some of which were recorded as missing by Lyon and Osgood in their Catalogue of the Type Specimens of Mammals in the United States National Museum, 1909. Some of these have since been returned to the former owner and are not here listed.

The sequence of orders and families is as far as possible that of Miller's List of North American Mammals, 1923 (1924), supplemented by the check-list of Osborn (1905) for fossil groups, and that of Kellogg (1928) for the Cetacea. The species are arranged alphabetically under their respective families. In general, I have followed the method of Lyon and Osgood in giving first, the name under which each type was described, then the reference to the original description, followed by a brief statement as to the nature of the specimen, its Museum of Comparative Zoölogy number or Bangs Collection number (for the latter collection has been incorporated without change of numbers), the locality, date, and collector. Where the name in current use is different from that under which the specimen was described, the present-day equivalent is added.

No attempt has been made to list specimens of which additional mention is made in the original accounts (paratypes), nor of specimens that have been figured but do not form the basis of original descriptions (plesiotypes).

In all, the types or cotypes forming the basis of 299 names are here included. Some of them are more or less historic specimens, whose location has undoubtedly in many cases been lost sight of, so that it may be of value to make the present record.

MARSUPIALIA

Didelphiidae

Didelphis marsupialis particeps Goldman

Proc. Biol. Soc. Washington, **30**, p. 107, 23 May 1917.

Holotype.— Male, skin and skull, 8,439 (E. A. and O. Bangs Coll.). Panama, San Miguel Island. 8 May 1900. W. W. Brown, Jr.

Didelphis virginiana pigra Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 172, March 1898.

Holotype.— Female, skin and skull, 3,500 (E. A. and O. Bangs Coll.). Florida, Brevard County, Oak Lodge, on the east peninsula opposite Micco. 31 January 1896. Outram Bangs.

Marmosa fulviventer Bangs

Amer. Nat., **35**, p. 632, August 1901.

Holotype.— Male, skin and skull, 8,435 (E. A. and O. Bangs Coll.). Panama, San Miguel Island. 28 April 1900. W. W. Brown, Jr.

Marmosa mitis Bangs

Proc. Biol. Soc. Washington, **12**, p. 162, 10 August 1898.

Holotype.— Male, skin and skull, 8,123 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Pueblo Viejo, 8,000 feet. 25 March 1898. W. W. Brown, Jr.

Marmosa robinsoni Bangs

Proc. Biol. Soc. Washington, **12**, p. 95, 30 April 1898.

Holotype.— Male, skin and skull, 7,749 (E. A. and O. Bangs Coll.). Venezuela, Margarita Island. 12 July 1895. Wirt Robinson.

Philander cicur Bangs

Proc. Biol. Soc. Washington, **12**, p. 161, 10 August 1898.

Holotype.— Female, skin and skull, 8,114 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Pueblo Viejo. 27 March 1898. W. W. Brown, Jr.

Peramelidae

Suillomeles hispidus G. M. Allen and T. Barbour

Proc. New England Zoöl. Club, **4**, p. 44, pls. 2, 3, 12 July 1909.

Holotype.— Skin and skull, M. C. Z. 7,006. Netherlands, New Guinea, Doreh Bay, Manokwari. 23 February 1907. Thomas Barbour.

INSECTIVORA

† Nesophontidae

† Nesophontes micrus G. M. Allen

Bull. Mus. Comp. Zoöl., **61**, p. 5, pl., fig. 14, January 1917.

Holotype.— Posterior half of right ramus, M. C. Z. 9,600. Cuba, Province of Matanzas, cave in Sierra de Hato Nuevo. Carlos de la Torre.

Talpidae

Neurotrichus gibbsi hyacinthinus Bangs

Amer. Nat., **31**, p. 240, fig. 2, 1 March 1897.

Holotype.— Female, skin and skull, 1,240 (E. A. and O. Bangs Coll.). California, Marin County, Nicasio. 10 March 1894. C. A. Allen.

Scalops anastasae Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 212, March 1898.

Holotype.— Male, skin and skull, 7,192 (E. A. and O. Bangs Coll.). Florida, Anastasia Island, Point Romo. 16 February 1897. Outram Bangs.

= *Scalopus aquaticus anastasae* (Bangs).

Scalops texanus aereus Bangs

Proc. Biol. Soc. Washington, **10**, p. 138, 28 December 1896.

Holotype.— Female, skin and skull, 5,475 (E. A. and O. Bangs Coll.). Oklahoma, Stilwell. 13 August 1896. Thaddeus Surber.
= *Scalopus aereus* (Bangs).

Scapanus californicus minusculus Bangs

Proc. New England Zoöl. Club, **1**, p. 70, 31 July 1899.

Holotype.— Female, skin and skull, 9,189 (E. A. and O. Bangs Coll.). California, Eldorado County, Fyffe. 10 June 1897. W. W. Price and E. M. Nutting.
= *Scapanus latimanus minusculus* Bangs.

Soricidae

Blarina brevicauda aloga Bangs

Proc. New England Zoöl. Club, **3**, p. 76, 31 March 1902.

Holotype.— Male, skin and skull, 9,727 (E. A. and O. Bangs Coll.). Massachusetts, Marthas Vineyard, West Tisbury. 25 June 1899. Outram Bangs.

Blarina brevicauda compacta Bangs

Proc. New England Zoöl. Club, **3**, p. 77, 31 March 1902.

Holotype.— Male, skin and skull, 9,705 (E. A. and O. Bangs Coll.). Massachusetts, Nantucket Island. 10 July 1899. Outram Bangs.

Crocidura maurisca geata G. M. Allen and A. Loveridge

Proc. Boston Soc. Nat. Hist., **38**, p. 417, 19 December 1927.

Holotype.— Adult male, skin and skull, M. C. Z. 22,447. Tanganyika Territory, Nyingwa, Uluguru Mountains. 19 October 1926. Arthur Loveridge.

Cryptotis avia G. M. Allen

Proc. New England Zoöl. Club, **8**, p. 37, 12 February 1923.

Holotype.— Skin and skull, M. C. Z. 20,091. Colombia, El Verjón. October 1922. Nicéforo Maria.

Neosorex palustris acadicus G. M. Allen

Proc. Biol. Soc. Washington, **28**, p. 15, 12 February 1915.

Holotype.— Female, skin and skull, 2,046 (E. A. and O. Bangs Coll.). Nova Scotia, Digby. 26 July 1894. Outram Bangs.
= *Sorex palustris gloveralleni* Jackson.

Sorex araneus ultimus G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 51, 9 April 1914.

Holotype.— Male, skin and skull, M. C. Z. 15,000. Northeastern Siberia, Nijni Kolymsk, near mouth of the Kolyma River. 6 November 1911. Johan Koren.

Sorex macropygmaeus koreni G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 56, 9 April 1914.

Holotype.— Female, skin and skull, M. C. Z. 15,085. Northeastern Siberia, Nijni Kolymsk, near mouth of the Kolyma River. 19 October 1911. Johan Koren.

Sorex personatus miscix Bangs

Proc. New England Zoöl. Club, **1**, p. 15, 28 February 1899.

Holotype.— Male, skin and skull, 8,651 (E. A. and O. Bangs Coll.). Labrador peninsula, Black Bay. 10 October 1898. Ernest Doane.
= *Sorex cinereus miscix* Bangs.

Sorex sanguinidens G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 54, 9 April 1914.

Holotype.— Female, skin and skull, M. C. Z. 15,012. Northeastern Siberia, Nijni Kolymsk, near mouth of the Kolyma River. 11 December 1911. Johan Koren.

Sorex vir G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 52, 9 April 1914.

Holotype.— Female, skin and skull, M. C. Z. 15,068. Northeastern Siberia, Nijni Kolymsk, near mouth of the Kolyma River. 19 December 1911. Johan Koren.

Chrysochloridae

Chlorotalpa tropicalis G. M. Allen and A. Loveridge

Proc. Boston Soc. Nat. Hist., **38**, p. 418, December 1927.

Holotype.— Adult female, skin and skull, M. C. Z. 22,435. Tanganyika Territory, Bagilo, Uluguru Mountains. 5 October 1926. Arthur Loveridge.

CHIROPTERA

Pteropidae

Pteropus ariel G. M. Allen

Bull. Mus. Comp. Zoöl., **52**, p. 28, plate, figs. 1, 3, 1908.

Holotype.— Skin and skull, M. C. Z. 10,565. Maldive Islands, Male Atoll. 24 November 1901. Henry B. Bigelow.

Pteropus lanigera (sic) Harrison Allen

Proc. Amer. Phil. Soc., **28**, p. 70, 1890.

Cotype.— Skin only, M. C. Z. 7,023. (The other cotype is in the United States National Museum, skull 37,815, skin 19,066.) Samoa Islands (error; probably from Caroline Islands, see Andersen, Cat. Chiroptera Brit. Mus., 1912, **1**, p. 298). H. A. Ward.

= *Pteropus insularis* Hombron and Jacquinot.

Emballonuridae

Peropteryx canina phaea G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 222, July 1911.

Holotype.— Female, skin and skull, M. C. Z. 8,101. British West Indies, Grenada, Point Saline. 29 August 1910. G. M. Allen.

Rhynchiscus naso priscus G. M. Allen

Proc. Biol. Soc. Washington, **27**, p. 109, 10 July 1914.

Holotype.— Skin and skull, M. C. Z. 13,208. Mexico, Quintana Roo, Xcopen. 18 February 1912. James L. Peters.

Nycteridae

Nycteris revoili Robin

Bull. Soc. Philom. France, ser. 7, **5**, p. 90, 1881; Ann. des Sci. Nat., Zoöl., ser. 6, **13**, art. 2, p. 3. April 1881,

Cotype.— Female in alcohol, M. C. Z. 14,929. Somaliland. 1880 ? Revoil.

Hipposideridae

Hipposideros curtus G. M. Allen

Revue Zoöl. Africaine, **9**, p. 194, 1921.

Holotype.— Adult female in alcohol, M. C. Z. 19,305. Cameroons, Sakbayeme. 1920. Rev. George Schwab.

Hipposideros turpis Bangs

Amer. Nat., **35**, p. 561, 1901.

Holotype.— Female, skin and skull, M. C. Z. 10,003. Liu Kiu Islands, Ishigaki. 10 May 1899. I. Zensaku.

Phyllostomidae

Ametrida minor Harrison Allen

Proc. Boston Soc. Nat. Hist., **26**, p. 240, figs. 1–4, May 1894.

Holotype.— Male in alcohol, skull dry, M. C. Z. 11,274. "Locality unknown," but probably Paramaribo, Surinam (see Proc. Biol. Soc. Washington, **15**, p. 88, 1902). 1832? F. W. Cragin.

Artibeus femurvillosum Bangs

Proc. New England Zoöl. Club, **1**, p. 73, 24 November 1899.

Holotype.— Male, skin and skull, 8,314 (E. A. and O. Bangs Coll.). Colombia, La Concepcion, 3,000 feet. 21 March 1899. W. W. Brown, Jr.

= *Artibeus jamaicensis palmarum* Allen and Chapman.

Chilonycteris parnellii pusillus G. M. Allen

Proc. Biol. Soc. Washington, **30**, p. 168, 23 October 1917.

Holotype.— Female, skin and skull, M. C. Z. 16,468. West Indies, Santo Domingo, Arroyo Salado. 7 March 1916. James L. Peters.

Chilonycteris torrei G. M. Allen

Proc. New England Zoöl. Club, **6**, p. 4, pl. 1, figs. 1, 3, 8 February 1916.

Holotype.— Female in alcohol, and dry skull, M. C. Z. 11,672. Cuba, Baracoa, La Cueva de la Majana. 15 June 1915. V. J. Rodriguez y Verrier.

Erophylla sezekorni syops G. M. Allen

Proc. Biol. Soc. Washington, **30**, p. 167, 23 October 1917.

Holotype.— Male in alcohol, and dry skull, M. C. Z. 13,713. Jamaica, Montego Bay. 14 March 1912. Joseph A. Cushman.

Glossophaga longirostris Miller

Proc. Acad. Nat. Sci. Philadelphia, p. 330, 1898.

Holotype.— Female, skin and skull, 8,046 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains. 10 February 1898. W. W. Brown, Jr.

Lonchophylla hesperia G. M. Allen

Bull. Mus. Comp. Zoöl., **52**, p. 35, plate, fig. 7, July 1908.

Holotype.— Male in alcohol, M. C. Z. 7,011. Peru, Zorritos. F. H. Bradley.

Vampyrodes major G. M. Allen

Bull. Mus. Comp. Zoöl., **52**, p. 38, July 1908.

Holotype.— Female in alcohol, M. C. Z. 6,756. Isthmus of Panama, San Pablo (now covered by Gatun Lake). Allen Lesley.

Vampyrops umbratus Lyon

Proc. Biol. Soc. Washington, **15**, p. 151, 20 June 1902.

Holotype.— Male, skin and skull, 8,180 (E. A. and O. Bangs Coll.). Colombia, San Miguel. 8 June 1898. W. W. Brown, Jr.

Vampyrops zarhinus Harrison Allen

Proc. Acad. Nat. Sci. Philadelphia, p. 400, 1891.

Holotype.— Female in alcohol, M. C. Z. 3,211. Panama, Obispo. 1872. Hassler Expedition.

(The locality is recorded as above in the museum catalogue. Harrison Allen, however, gives it as Brazil, from the Thayer Expedition.)
= *Vampyrops helleri* Peters.

Thyropteridae

Thyroptera tricolor albigula G. M. Allen

Proc. New England Zoöl. Club, **9**, p. 1, 10 December 1923.

Holotype.— Adult female in alcohol, M. C. Z. 20,143. Western Panama, Gutierrez, 25 miles inland from Chiriquicito. August 1923. Emmett R. Dunn and Chester B. Duryea.

Vespertilionidae

Atalapha brachyotis J. A. Allen

Bull. Amer. Mus. Nat. Hist., **4**, p. 47, May 1892.

Holotype.— Male in alcohol, M. C. Z. 11,143. Galapagos group, Chatham Island. 23 June 1891. George Baur.
Note.— The skull had been removed and was missing when received.
= *Lasiurus brachyotis* (J. A. Allen).

Corynorhinus phyllotis G. M. Allen

Bull. Mus. Comp. Zoöl., **60**, p. 352, pl. 1, figs. 5, 6, April 1916.

Holotype.— Skin and skull, M. C. Z. 5,943. Mexico, San Luis Potosi. 24 March 1878. Edward Palmer.

Eptesicus phasma G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 327, 1911.

Holotype.— Male, skin and skull, M. C. Z. 8,279. Kenya Colony, East Africa, Meru River (affluent of northern Guaso Nyiro). 6 August 1909. G. M. Allen.

Harpiocephalus rufulus G. M. Allen

Proc. Biol. Soc. Washington, **26**, p. 214, 20 December 1913.

Holotype.— Male, skin and skull, M. C. Z. 14,206. Tonkin, Lao-kai. 3 January 1912. Kobayashi.

Myotis albicinctus G. M. Allen

Journ. Mammalogy, **1**, p. 2, 28 November 1919.

Holotype.— Adult male, skin and skull, M. C. Z. 11,747. California, Mt. Whitney, 11,000 feet. G. M. Allen.
= *Myotis lucifugus carissima* Thomas.

Myotis sodalis Miller and Allen

Bull. U. S. Nat. Mus., no. 144, p. 130, 1928.

Holotype.— Adult female, skin and skull, M. C. Z. 10,980. Indiana, Wyandotte Cave. 7 March 1904. J. O. Sibert.

Nycticeius africanus G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 328, 1911.

Holotype.— Male, skin and skull, M. C. Z. 8,272. Kenya Colony, East Africa, Meru River (an affluent of northern Guaso Nyiro). 11 August 1909. G. M. Allen.

Plecotus sacrimontis G. M. Allen

Bull. Mus. Comp. Zoöl., **52**, p. 50, pl., fig. 6, 1908.

Holotype.— Male in alcohol, M. C. Z. 6,932. Japan, Mt. Fuji. 4 December 1906. Alan Owston.
= *Plecotus auritus sacrimontis* G. M. Allen.

Scabrifer notius G. M. Allen

Bull. Mus. Comp. Zoöl., **52**, p. 46, 1908.

Holotype.— Male in alcohol, M. C. Z. 4,555. South Africa, Cape Town.
= *Rhinopterus notius* (G. M. Allen).

Scotophilus altilis G. M. Allen

Bull. Mus. Comp. Zoöl., **58**, p. 350, 1914.

Holotype.— Male, skin and skull, M. C. Z. 14,463. Sudan, Blue Nile, Aradeiba, above Roseires. 22 January 1913. Phillips Sudan Expedition, G. M. Allen.

Molossidae

Chaerephon leucostigma G. M. Allen

Bull. Mus. Comp. Zoöl., **61**, p. 513, February 1918.

Holotype.— Female, skin and skull, M. C. Z. 16,344. Madagascar, Tananarive. December 1915. Frederic R. Wulsin.

CARNIVORA

† Hyaenodontidae

† Hyaenodon leptocephalus Scott

Bull. Mus. Comp. Zoöl., **13**, p. 152, fig. 1, September 1887; Journ. Acad. Nat. Sci. Philadelphia, ser. 2, **9**, p. 175, October 1887.

Cotypes.— Skulls, M. C. Z. 6,693, 6,694 (Bone catalogue). South Dakota, White River beds, Oligocene. July 1880. S. W. Garman.

Ursidae

Ursus (Euarctos) americanus sornborgeri Bangs

Amer. Nat., **32**, p. 500, July 1898.

Holotype.— Young female (?), skull, 7,411 (E. A. and O. Bangs Coll.). Labrador, Okak. Summer, 1897. J. D. Sornborger.
= *Euarctos americanus americanus* (Pallas).

Procyonidae

Procyon lotor elucus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 219, March 1898.

Holotype.— Male, skin and skull, 3,502 (E. A. and O. Bangs Coll.). Florida, Brevard County, Oak Lodge, east peninsula opposite Micco. 15 February 1895. Outram Bangs.

Procyon gloveralleni Nelson and Goldman

Journ. Mammalogy, **11**, p. 453, 11 November 1930.

Holotype.— Immature male, skin and skull, M. C. Z. 18,591. British West Indies, island of Barbados. 1920. Sir Francis Watts.

Procyon maynardi Bangs

Proc. Biol. Soc. Washington, **12**, p. 92, 30 April 1898.

Holotype.— Male, skin and skull, 7,750 (E. A. and O. Bangs Coll.). Bahamas, New Providence Island, Nassau. August 1897. H. L. Claridge.

Mustelidae

Lutra degener Bangs

Proc. Biol. Soc. Washington, **12**, p. 35, 24 March 1898.

Holotype.— Male, skin and skull, 6,965 (E. A. and O. Bangs Coll.). Newfoundland, Bay St. George. 23 April 1897. Ernest Doane.

Lutra hudsonica vaga Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 224, fig., March 1898.

Holotype.— Male, skin and skull, 5,749 (E. A. and O. Bangs Coll.). Florida, Brevard County, Micco. 17 March 1897. F. R. Hunter.
= *Lutra canadensis vaga* Bangs.

Mephitis avia Bangs

Proc. Biol. Soc. Washington, **12**, p. 32, 24 March 1898.

Holotype.— Male, skin and skull, 5,747 (E. A. and O. Bangs Coll.). Illinois, San Jose. 10 March 1897. H. H. and C. S. Brimley.
= *Mephitis mesomelas avia* Bangs.

Mephitis mephitica elongata Bangs

Proc. Boston Soc. Nat. Hist., **26**, p. 531, 31 July 1895.

Holotype.— Male, skin and skull, 3,051 (E. A. and O. Bangs Coll.). Florida, Micco. 5 March 1895. Outram Bangs.
= *Mephitis elongata* Bangs.

Mephitis mephitica scrutator Bangs

Proc. Biol. Soc. Washington, **10**, p. 141, 28 December 1896.

Holotype.— Male, skin and skull, 2,889 (E. A. and O. Bangs Coll.). Louisiana, Acadia Parish, Cartville. 25 May 1895. F. L. Small.
= *Mephitis mesomelas mesomelas* Lichtenstein.

Mephitis spissigrada Bangs

Proc. Biol. Soc. Washington, **12**, p. 31, 24 March 1898.

Holotype.— Female, skin and skull, 3,699 (E. A. and O. Bangs Coll.). British Columbia, Sumas. 30 September 1895. Allan C. Brooks.
= *Mephitis occidentalis spissigrada* Bangs.

Mustela atrata Bangs

Amer. Nat., **31**, p. 162, 1 February 1897.

Holotype.— Female, skin and skull, 5,752 (E. A. and O. Bangs Coll.). Newfoundland, Bay St. George. 29 September 1896. Ernest Doane.
= *Martes atrata* (Bangs).

Mustela brumalis Bangs

Amer. Nat., **32**, p. 502, figs., July 1898.

Holotype.— Probably male, skull, 7,417 (E. A. and O. Bangs Coll.). Labrador, Okak. Summer, 1897. J. D. Sornborger.
= *Martes brumalis* (Bangs).

Mustela cicognanii mortigena Bangs

Bull. Mus. Comp. Zoöl., **54**, p. 511, July 1913.

Holotype.— Male, skin and skull, 3,745 (E. A. and O. Bangs Coll.). Newfoundland, Bay St. George. 27 September 1895. Ernest Doane.

Putorius frenatus neomexicanus Barber and Cockerell

Proc. Acad. Nat. Sci. Philadelphia, p. 188, 3 May 1898.

Holotype.— Male, skin and skull, M. C. Z. 10,475. New Mexico, Mesilla, shore of Armstrong's Lake. 1 February 1898. A. C. Tyson.
= *Mustela frenata neomexicana* (Barber and Cockerell).

Putorius (Arctogale) longicauda oribasus Bangs.

Proc. New England Zoöl. Club, **1**, p. 81, 27 December 1899.

Holotype.— Female, skin and skull, 9,058 (E. A. and O. Bangs Coll.). British Columbia, source of Kettle River, 7,500 feet. 10 September 1898. Allan C. Brooks.
= *Mustela longicauda oribasus* (Bangs).

Putorius (Lutreola) lutensis Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 229, fig., March 1898.

Holotype.— Male, skin and skull, 7,225 (E. A. and O. Bangs Coll.). Florida, salt marsh opposite Matanzas Inlet. 16 February 1897. Outram Bangs.

= *Mustela vison lutensis* (Bangs).

Putorius (Arctogale) muricus Bangs

Proc. New England Zoöl. Club, **1**, p. 71, 31 July 1899.

Holotype.— Male, skin and skull, 9,146 (E. A. and O. Bangs Coll.). California, Eldorado County, Echo, 7,500 feet. 15 July 1897. W. W. Price and E. M. Nutting.

= *Mustela murica* (Bangs).

Putorius noveboracensis notius Bangs

Proc. New England Zoöl. Club, **1**, p. 53, 9 June 1899.

Holotype.— Male, skin and skull, 2,678 (E. A. and O. Bangs Coll.). North Carolina, Buncombe County, Weaverville. 10 July 1892. J. S. Cairns.

= *Mustela noveboracensis notia* (Bangs).

Putorius occisor Bangs

Proc. New England Zoöl. Club, **1**, p. 54, 9 June 1899.

Holotype.— Male, skin and skull, 9,102 (E. A. and O. Bangs Coll.). Maine, Bucksport. 15 January 1899. Alvah G. Dorr.

= *Mustela noveboracensis occisor* (Bangs).

Putorius rixosus Bangs

Proc. Biol. Soc. Washington, **10**, p. 21, pl. 1, fig. 6; pl. 2, fig. 6; pl. 3, fig. 4, 25 February 1896.

Holotype.— Female, skin and skull, 642 (E. A. and O. Bangs Coll.). Saskatchewan, Osler. 15 July 1893. W. C. Colt.

= *Mustela rixosa rixosa* (Bangs).

Putorius vison energumenos Bangs

Proc. Boston Soc. Nat. Hist., **27**, p. 5, pl. 2, fig. 3, March 1896.

Holotype.— Male, skin and skull, 3,555 (E. A. and O. Bangs Coll.). British Columbia, Sumas. 23 September 1895. Allan C. Brooks.

= *Mustela vison energumenos* (Bangs).

PUTORIUS (LUTREOLA) VULGIVAGUS Bangs

Proc. Boston Soc. Nat. Hist., **26**, p. 539, 31 July 1895.

Holotype.— Male, skin and skull, 2,751 (E. A. and O. Bangs Coll.). Louisiana, Burbridge. 10 January 1895. F. L. Small.
= *Mustela vison vulgivaga* (Bangs).

PUTORIUS XANTHOGENYS MUNDUS Bangs

Proc. New England Zoöl. Club, **1**, p. 56, 9 June 1899.

Holotype.— Male, skin and skull, 5,459 (E. A. and O. Bangs Coll.). California, Marin County, Point Reyes. 19 June 1896. Charles A. Allen.
= *Mustela xanthogenys munda* (Bangs).

SPILOGALE AMBARVALIS Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 222, March 1898.

Holotype.— Male, skin and skull, 3,481 (E. A. and O. Bangs Coll.). Florida, Brevard County, Oak Lodge, east peninsula opposite Micco. 30 January 1895. Outram Bangs.

CANIDAE

† AMPHICYON ESERI Plieninger

Jahreshefte d. Ver. f. vaterländ. Naturk. in Württemberg, Stuttgart, **5**, pt. 2, p. 216, pl. 1, fig. 9, 1849.

Holotype.— Upper right carnassial, M. C. Z. 9,190. Germany, Württemburg, Ober Kirchberg an der Iller (Miocene). About 1849. Eser Collection.

NOTE.— This is the specimen listed by Cushman (Proc. Boston Soc. Nat. Hist., **33**, p. 272, 1907) as in the palaeontological collection of the Boston Society of Natural History; it has since been transferred to the Museum of Comparative Zoölogy.

†CANIS MISSISSIPPIENSIS J. A. Allen

Amer. Journ. Sci., ser. 3, **11**, p. 48, January 1876.

Cotypes.— A right humerus, M. C. Z. 10,988; an imperfect left tibia, M. C. Z. 10,990; the distal two thirds of a right femur, M. C. Z. 10,991. Wisconsin, Blue Mounds (lead crevices, Pleistocene). 1857. J. D. Whitney.

Note.— In the original description no exact locality or date is given. These are found in J. D. Whitney, "Report of a Geological Survey of the Upper Mississippi Lead Region," pp. 310, 311, 423, 1862.
= †*Aenocyon dirus* (Leidy).

Cerdocyon thous germanus G. M. Allen

Proc. Biol. Soc. Washington, **36**, p. 55, 28 March 1923.

Holotype.— Skin and skull, M. C. Z. 19,850. Colombia, high savanna of Bogotá, 9,000 feet. Nicéforo Maria.

† Pachycyon robustus J. A. Allen

Mem. Mus. Comp. Zoöl., **10**, art. 2, p. 4, pl. 1–3, December 1885.

Holotype.— Scapula, humerus, pelvis, femur, tibia, M. C. Z. 7,091. Virginia, Lee County, Ely Cave. ? 1875. N. S. Shaler.
= *Canis familiaris* Linné, 1758 (an aboriginal Indian dog).

Urocyon aquilus Bangs

Proc. Biol. Soc. Washington, **12**, p. 93, 30 April 1898.

Holotype.— Male, skin and skull, 8,001 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, between 2,000 and 3,000 feet. 10 February 1898. W. W. Brown, Jr.
= *Cerdocyon thous aquilus* (Bangs).

Urocyon cinereoargenteus furvus G. M. Allen and T. Barbour

Bull. Mus. Comp. Zoöl., **65**, p. 266, 26 February 1923.

Holotype.— ?Female, skin and skull, M. C. Z. 19,774. Panama Canal Zone, three miles west of Balboa. Dr. Herbert Clark.

Urocyon cinereoargenteus ocythous Bangs

Proc. New England Zoöl. Club, **1**, p. 43, 5 June 1899.

Holotype.— Female, skin and skull, 4,290 (E. A. and O. Bangs Coll.). Wisconsin, Grant County, Platteville. 25 January 1896. N. E. France.

Vulpes deletrix Bangs

Proc. Biol. Soc. Washington, **12**, p. 36, 24 March 1898.

Holotype.— Female, skin and skull, 6,967 (E. A. and O. Bangs Coll.). Newfoundland, Bay St. George. 24 April 1897. Ernest Doane.

Vulpes pennsylvanica rubricosa Bangs

Science, new ser., **7**, p. 272, 25 February 1898.

Holotype.— Female, skin and skull, 116 (E. A. and O. Bangs Coll.). Nova Scotia, Digby. 3 November 1893. Outram Bangs.

New name for *Vulpes pennsylvanica vafra* Bangs (Proc. Biol. Soc. Washington, **11**, p. 53, 16 March 1897), not *Vulpes vafer* Leidy, 1869.

= *Vulpes fulva rubricosa* Bangs.

Vulpes fulvus rubricatus Miller

Bull. N. Y. State Mus., **8**, no. 38, p. 128, 1900.

"Accidental renaming" of *V. pennsylvanica rubricosa* Bangs (*q. v.*).

= *Vulpes fulva rubricosa* Bangs.

Vulpes rubricosa bangsi Merriam

Proc. Washington Acad. Sci., **2**, p. 667, 28 December 1900.

Holotype.— Female, skin and skull, 8,880 (E. A. and O. Bangs Coll.). Labrador peninsula, Lance au Loup, Strait of Belle Isle. 2 October 1899. Ernest Doane.

= *Vulpes fulva bangsi* Merriam.

Felidae

Felis bangsi Merriam

Proc. Washington Acad. Sci., **3**, p. 595, 11 December 1901.

Holotype.— Male, skin and skull, 8,413 (E. A. and O. Bangs Coll.). Colombia, Dibulla. 8 October 1899. W. W. Brown, Jr.

= *Felis concolor bangsi* Merriam.

Felis bangsi costaricensis Merriam

Proc. Washington Acad. Sci., **3**, p. 596, 11 December 1901.

Holotype.— Female, skin and skull, M. C. Z. 10,118. Panama, Chiriqui, Boquete. 22 April 1901. W. W. Brown, Jr.

= *Felis concolor costaricensis* Merriam.

Felis capensis phillipsi G. M. Allen

Bull. Mus. Comp. Zoöl., **58**, p. 337, July 1914.

Holotype.— Male, skin and skeleton, M. C. Z. 14,908. Sudan, Blue Nile, El Garef. 10 January 1913. John C. Phillips and G. M. Allen.

Felis coryi Bangs

Proc. Biol. Soc. Washington, **13**, p. 15, 31 January 1899.

Holotype.— Male, skin and skull, 7,742 (E. A. and O. Bangs Coll.). Florida, wilderness back of Sebastian. 1 January 1898. F. R. Hunter.
= *Felis concolor coryi* Bangs.

Felis improcera Phillips

Proc. Biol. Soc. Washington, **25**, p. 85, pl. 5, 4 May 1912.

Holotype.— Male, skin and skull, M. C. Z. 12,704. Mexico, Lower California, Calmalli. September 1911. E. W. Funcke.
= *Felis concolor improcera* Phillips.

† ? Felis maxima Scott

Bull. Mus. Comp. Zoöl., **20**, p. 70, fig. 4, November 1890.

Holotype.— Humerus, M. C. Z. 9,050 (the distal epicondylus, originally a part of the specimen, has been broken off and lost). Kansas, Loup Fork (?Pliocene). C. H. Sternberg.

Lynx (Cervaria) fasciatus oculeus Bangs

Proc. New England Zoöl. Club, **1**, p. 23, 31 March 1899.

Holotype.— Male, skin and skull, 8,633 (E. A. and O. Bangs Coll.). California, Marin County, Nicasio. 11 December 1898. Charles A. Allen.

Lynx gigas Bangs

Proc. Biol. Soc. Washington, **11**, p. 50, pl. 2, fig. 1, 16 March 1897.

Holotype.— Male, skin and skull, 4,951 (E. A. and O. Bangs Coll.). Nova Scotia, fifteen miles back of Bear River. 11 December 1895.

Lynx subsolanus Bangs

Proc. Biol. Soc. Washington, **11**, p. 49, pl. 2, fig. 2, 16 March 1897.

Holotype.— Male, skin and skull, 1,190 (E. A. and O. Bangs Coll.). Newfoundland, Codroy. 13 June 1894. Ernest Doane.

PRIMATES

Cebidae

Cebus curtus Bangs

Bull. Mus. Comp. Zoöl., **46**, p. 91, 1905.

Holotype.— Male, skin and skull, M. C. Z. 10,824. Colombia, Gorgona Island. 2 July 1904. W. W. Brown, Jr.

Pongidae

Troglodytes gorilla Savage and Wyman

Proc. Boston Soc. Nat. Hist., **2**, p. 245, August 1847; Boston Journ. Nat. Hist., **5**, p. 417, pl. 40–43, December 1847.

The specimens on which this species was based were: four skulls, two of them male, two female, "one of each in a perfect condition, and all of them adult"; a male and a female pelvis; "the long bones of the upper and lower extremities"; a "few vertebrae and ribs," of which two cervicals, the twelfth dorsal and two lumbar vertebrae of a male are alone specifically mentioned (wrongly referred to a female in table). Of these cotypes the following have been transferred to the museum by the Boston Society of Natural History:

M. C. Z. 9,587, skull, male, figured in plates 40, 42 (lacks three incisors and right canine).

M. C. Z. 9,311, skull, female, figured in plates 41, 43.

M. C. Z. 9,488, pelvis with sacrum of same male.

M. C. Z. 9,489, pelvis with sacrum of same female.

M. C. Z. 10,686, atlas and two dorsal vertebrae of above female.

M. C. Z. 10,687, twelve ribs.

M. C. Z. 10,688, two cervical, three dorsal, and two lumbar vertebrae of above male.

M. C. Z. 10,690, both scapulae, humeri, one ulna, the radii, femora and one tibia of same male.

West Africa, Gaboon, Empongwe, near mouth of the Gaboon River. 1847. Thomas S. Savage, M.D.

= *Gorilla gorilla gorilla* (Savage and Wyman).

RODENTIA

Graphiuridae

Graphiurus microtis griseus G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 440, April 1912.

Holotype.— Male, skin and skull, M. C. Z. 8,244. Kenya Colony, northern Guaso Nyiro. 25 July 1909. G. M. Allen.
= *Claviglis murinus griseus* (G. M. Allen).

Graphiurus schwabi G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 441, April 1912.

Holotype.— Skin and skull, M. C. Z. 8,607. Cameroons, Kribi. 1911. Rev. George Schwab.
= *Claviglis schwabi* (G. M. Allen).

Sciuridae

Arctomys flaviventer avarus Bangs

Proc. New England Zoöl. Club, **1**, p. 68, 31 July 1899.

Holotype.— Female, skin and skull, 7,299 (E. A. and O. Bangs Coll.). British Columbia, Okanagan. 17 July 1897. Allan C. Brooks.
= *Marmota flaviventris avara* (Bangs).

Arctomys ignavus Bangs

Proc. New England Zoöl. Club, **1**, p. 13, 28 February 1899.

Holotype.— Male, skin and skull, 7,971 (E. A. and O. Bangs Coll.). Labrador peninsula, Black Bay. 13 July 1898. Ernest Doane.
= *Marmota monax ignava* (Bangs).

Citellus obscurus siccus G. M. Allen

Amer. Mus. Novitates, no. 163, p. 3, 2 April 1925.

Holotype.— Adult female, skin and skull, M. C. Z. 19,924. China, Shansi, ten miles west of Taiyuanfu. August 1921. Frederic R. Wulsin.

Dremomys pernyi flavior G. M. Allen

Proc. Biol. Soc. Washington, **25**, p. 178, 24 December 1912.

Holotype.— Male, skin and skull, M. C. Z. 13,691. Southeastern Yunnan, Mongtze. 1911. Bought of Kobayashi.

DREMOMYS SENEX G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 229, August 1912.

Holotype.— Female, skin and skull, M. C. Z. 7,582. China, Hupeh, Ichanghsien, Nantow. 5 February 1909. Walter R. Zappey.

SCIUROTAMIAS DAVIDIANUS THAYERI G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 231, August 1912.

Holotype.— Male, skin, M. C. Z. 8,008. China, central Szechwan, Washan, 6,000 feet. 17 May 1908. Walter R. Zappey.

SCIURUS (GUERLINGUETUS) AESTUANS CHIRIQUENSIS BANGS

Bull. Mus. Comp. Zoöl., **39**, p. 22, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,044. Panama, Chiriqui, Divalá. 18 November 1900. W. W. Brown, Jr.
= *Sciurus hoffmanni chiriquensis* Bangs.

SCIURUS (MICROSCIURUS) BROWNI Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 24, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,404. Panama, Chiriqui Province, Bogaba. 15 July 1901. W. W. Brown, Jr.
= *Microsciurus alfari browni* (Bangs).

SCIURUS CAROLINENSIS EXTIMUS Bangs

Proc. Biol. Soc. Washington, **10**, p. 158, pl. 9, fig. 4, 28 December 1896.

Holotype.— Female, skin and skull, 4,519 (E. A. and O. Bangs Coll.). Florida, Dade County, Miami. 12 March 1895. L. Brownell.

SCIURUS CAROLINENSIS var. YUCATANENSIS J. A. Allen

Monographs N. Amer. Rodentia, p. 705, August 1877.

Cotype.— Female, skin, M. C. Z. 5,398 (formerly U. S. N. M. 8,502). Yucatan, Merida. March 1865. Dr. A. Schott. Gift of Smithsonian Institution, 1874.
= *Sciurus yucatanensis yucatanensis* J. A. Allen.

Sciurus castaneoventris haemobaphes G. M. Allen

Proc. Biol. Soc. Washington, **25**, p. 177, 24 December 1912.

Holotype.— Male, skin and skull, M. C. Z. 13,693. Southeastern Yunnan, Chihping. 26 February 1911. Kobayashi.

= *Callosciurus erythraeus haemobaphes* (G. M. Allen).

Sciurus castanotus Baird

Proc. Acad. Nat. Sci. Philadelphia, p. 332, 1855.

Cotype.— Skin, M. C. Z. 4,692 (formerly U. S. N. M. 122/1,108). New Mexico, Grant County, copper mines (near present Georgetown). Winter, 1851. J. H. Clark. Gift of Smithsonian Institution, 1874.

Note.— No type is designated in the original description, but in the Mammals of N. America it is seen that there were two specimens, of which U. S. N. M. 121/1,107 is the other cotype. Because of the correspondence of the skull measurements of this latter, with those published in the original description, Lyon and Osgood regard it as the type, though strictly both are cotypes.

= *Sciurus aberti* Woodhouse.

Sciurus hudsonicus gymnicus Bangs

Proc. New England Zoöl. Club, **1**, p. 28, 31 March 1899.

Holotype.— Female, skin and skull, 4,914 (E. A. and O. Bangs Coll.). Maine, Greenville (near Moosehead Lake). 1 December 1895. C. H. Goldthwaite.

Sciurus hudsonicus loquax Bangs

Proc. Biol. Soc. Washington, **10**, p. 161, pl. 10, fig. 1, 28 December 1896.

Holotype.— Male, skin and skull, 4,270 (E. A. and O. Bangs Coll.). Connecticut, Liberty Hill. 24 December 1895. Outram Bangs.

Sciurus hudsonicus orarius Bangs

Proc. Biol. Soc. Washington, **11**, p. 281, 30 December 1897.

Holotype.— Female, skin and skull, 4,978 (E. A. and O. Bangs Coll.). California, Mendocino County, Philo. 9 December 1895. Charles A. Allen.

= *Sciurus douglasii mollipilosus* Audubon and Bachman.

Sciurus ludovicianus vicinus Bangs

Proc. Biol. Soc. Washington, **10**, p. 150, pl. 8, fig. 3, 28 December 1896.

Holotype.— Female, skin and skull, 5,215 (E. A. and O. Bangs Coll.). West Virginia, White Sulphur Springs. 29 January 1896. Thaddeus Surber.

= *Sciurus niger neglectus* Gray.

Sciurus nesaeus G. M. Allen

Proc. Biol. Soc. Washington, **15**, p. 93, 25 April 1902.

Holotype.— Female, skin with incisors, M. C. Z. 10,744. Venezuela, Margarita Island, El Valle. 8 July 1901. Austin H. Clark.

Sciurus variabilis morulus Bangs

Proc. New England Zoöl. Club, **2**, p. 43, 20 September 1900.

Holotype.— Female, skin and skull, 8,420 (E. A. and O. Bangs Coll.). Panama, Loma del Leon. 13 March 1900. W. W. Brown, Jr.

= *Sciurus gerrardi morulus* Bangs.

Sciurus variabilis saltuensis Bangs

Proc. Biol. Soc. Washington, **12**, p. 185, 16 November 1898.

Holotype.— Female, skin and skull, 8,144 (E. A. and O. Bangs Coll.). Colombia, Santa Marta, Pueblo Viejo, 8,000 feet. 26 March 1898. W. W. Brown, Jr.

= *Sciurus saltuensis* Bangs.

Spermophilus armatus Kennicott

Proc. Acad. Nat. Sci. Philadelphia, p. 158, 1863.

Wyoming, Fort Bridger (formerly part of Utah). April and May, 1858. C. Drexler. Gift of Smithsonian Institution, 1874.

The following cotypes are catalogued in the collection:

M. C. Z. 297, skull (formerly U. S. N. M. 4,799), but the skin accompanying it, U. S. N. M. 3,472, is not to be found.

M. C. Z. 4,790, skin (formerly U. S. N. M. 3,370); no record of skull.

M. C. Z. 4,791, skin (formerly U. S. N. M. 3368/4796), spoiled in making over and discarded.

M. C. Z. 4,793, skin and skull (formerly U. S. N. M. 3,378); skin made over and skull removed.

M. C. Z. 4,794, skull (formerly U. S. N. M. 3,374); skin spoiled in making over, and discarded.

Note.— No numbers are mentioned in the original description, hence "all the specimens from Fort Bridger collected by C. Drexler and in the collection prior to 1863 are evidently cotypes of the species. . . . The labels all have *armatus* written on them, possibly in Kennicott's own hand" (Lyon and Osgood, Bull. U. S. Nat. Mus., no. 62, p. 163, 1909). The United States National Museum catalogue numbers for the last four skins listed above, as given by these authors, are 3,470, 3,468, 3,478, 3,474, but on the original labels as identified by the collector's number, the same skins are numbered 3,370, 3,368, 3,378, 3,374 respectively.

= *Citellus armatus* (Kennicott).

Spermophilus obsoletus Kennicott

Proc. Acad. Nat. Sci. Philadelphia, p. 157, 1863.

Two of the cotypes are in the collection, viz.:

M. C. Z. 4817, skin. South Dakota (formerly Nebraska), Black Hills. Dr. F. V. Hayden. Gift of Smithsonian Institution, 1874. On the back of the original label are the words, "*Spermophilus obsoletus* type." This was formerly U. S. N. M. 3252/4795, but the skull is now lost.

M. C. Z. 4,819, skin. Nebraska, 220 miles west of Fort Kearney. 16 August 1857. Dr. J. G. Cooper. Gift of Smithsonian Institution, 1874. Formerly U. S. N. M. 3,223.

For a complete list of the cotypes, see Lyon and Osgood, Bull. U. S. Nat. Mus., no. 62, p. 168–169, 1909.

= *Citellus obsoletus* (Kennicott).

Spermophilus parryi kodiacensis J. A. Allen

Proc. Boston Soc. Nat. Hist., **16**, p. 292, 1874.

Cotypes.— Skin and skull, M. C. Z. 4,782, 4,783 (formerly U. S. N. M. 9,367, 9,360). Alaska, Kodiak Island. September 1868. F. Bischoff. Gift of Smithsonian Institution, 1874.

Note.— No type is designated in the original description but in the article on Sciuridae in Coues and Allen's Monographs of N. American Rodentia, p. 848, 1877 (of which the 1874 paper is a résumé), the specimens on which the name is based are listed as U. S. N. M. 9,358–9,362, 9,366–9,368, 9,242, all of which are, therefore, cotypes, though Lyon and Osgood make no mention of them in their list.

= *Citellus parryi kodiacensis* (J. A. Allen).

Spermophilus tridecimlineatus var. pallidus J. A. Allen

Proc. Boston Soc. Nat. Hist., **16**, p. 291, 1874.

No type was specified in the original description, but in his article on the Sciuridae in Coues and Allen's Monographs of N. American Rodentia, 1877, of which the paper of 1874 was a digest, Dr. Allen lists (on pp. 876, 877, 880, 881) sixty skins, four skulls, and nine alcoholics, which are all equally the cotypes upon which the species is based. Later, the same author (Bull. Amer. Mus. Nat. Hist., **7**, p. 338, 1895) restricted *pallidus* "to the arid region of the plains, from Upper Missouri southward to eastern Colorado . . . type region the plains of the Lower Yellowstone River."

Of the cotypes listed in 1877, the following are entered in the museum catalogue:

M. C. Z. 1,596, skin (formerly 3061/3310 U. S. N. M.). Wyoming, west of Laramie. 6 July 1857. W. S. Wood. Gift of Smithsonian Institution, 1868. Skull probably in United States National Museum.

M. C. Z. 2,655, skin. Wyoming, Cheyenne. 19 August 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,656, skin and teeth. Wyoming, Cheyenne. 19 August 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,657, skin. Colorado, Park County. 14 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,658, skin. Colorado, Fairplay. 15 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,659, skin (lost). Colorado, Park County, Hartsel's. 26 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,660, skin (discarded). Colorado, Park County, Hartsel's. 28 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,661, skin. Colorado, Park County, Hartsel's. 28 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,662, skin. Colorado, Park County, Hartsel's. 28 July 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 2,663. Wyoming, Cheyenne. 25 August 1871. J. A. Allen and C. W. Bennett. Rocky Mountain Expedition.

M. C. Z. 4,829, skin (formerly U. S. N. M. 9,644). Wyoming, Camp Carling. 26 July 1870. W. T. Schmidt. Gift of Smithsonian Institution, 1876.

M. C. Z. 4,830, skin (destroyed) and skull (formerly U. S. N. M. 3,220). Wyoming, Forks of Platte River. 9 August 1851. J. G. Cooper. Gift of Smithsonian Institution, 1874.

M. C. Z. 4,831, skin (formerly U. S. N. M. 3,038), now lost. Wyoming, Platte River. 2 July 1857. Dr. W. A. Hammond. Gift of Smithsonian Institution, 1874.

The remaining specimens listed by Dr. Allen are presumably in the United States National Museum, but Lyon and Osgood omit the subspecies from their list.

= *Citellus tridecimlineatus pallidus* (J. A. Allen).

Spermophilus (Ictidomys) tridecimlineatus badius Bangs

Proc. New England Zoöl. Club, **1**, p. 1, 8 February 1899.

Holotype.— Male, skin and skull, 1,682 (E. A. and O. Bangs Coll.). Missouri, Stotesbury. 17 April 1894. Thaddeus Surber.

= *Citellus tridecimlineatus badius* (Bangs).

Syntheosciurus brochus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 25, figs. 1–4, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,402. Panama, Chiriqui, Boquete, 7,000 feet. 30 April 1901. W. W. Brown, Jr.

Tamias cooperi Baird

Proc. Acad. Nat. Sci. Philadelphia, p. 334, 1855; see also Mammals of N. America, p. 301, 1857, for list of specimens.

One of the two cotypes, skin, M. C. Z. 4,754 (formerly U. S. N. M. 211/1,182). Washington, Klickitat Pass, Cascade Mountains. July 1853. Dr. J. G. Cooper. Gift of Smithsonian Institution, 1874.

Note.— The skin has been made over, but the skull cannot be found. The other cotype is U. S. N. M. 212/1,183.

= *Eutamias townsendi cooperi* (Baird).

Tamias dorsalis Baird

Proc. Acad. Nat. Sci. Philadelphia, p. 332, 1855; see also Mammals of N. America, p. 300, 1857, where types are designated.

One of the two cotypes, a made-over skin, M. C. Z. 4,759 (formerly U. S. N. M. 119/3,151). New Mexico, Grant County, copper mines of Mimbres River (near present Georgetown). 1851. J. H. Clark. Gift of Smithsonian Institution, 1874.

NOTE.— The mandible of this specimen is still in the United States National Museum, as is also the other cotype, a mounted skin, no. 120, with the same data.

= *Eutamias dorsalis dorsalis* (Baird).

TAMIAS QUADRIVITTATUS NEGLECTUS J. A. Allen

Bull. Amer. Mus. Nat. Hist., **3**, p. 106, June 1890.

Holotype.— Skin and skull, M. C. Z. 1,575. Ontario, eastern end of Lake Superior, near mouth of Montreal River. 5 July 1868. Louis Agassiz.

= *Eutamias minimus borealis* (J. A. Allen) in part, see A. H. Howell, N. American Fauna, no. 52, p. 56, 1929.

TAMIAS QUADRIVITTATUS B. var. PALLIDUS J. A. Allen

Proc. Boston Soc. Nat. Hist., **16**, p. 289, 1874.

No type was specified in the original paper, but in the Monographs of N. American Rodentia, 1877, a list of the fifty-three specimens examined, and on which the name is based, is given on pages 807, 808. These are, therefore, all cotypes, but since several distinct forms were included among them, Cary (Proc. Biol. Soc. Washington, **19**, p. 88, 1906) has proposed to regard Camp Thorne, Yellowstone River, Montana, as the type locality. Of the three specimens listed from there, one is still in the United States National Museum (no. 11,656) and is regarded as a lectotype by Lyon and Osgood; the second is M. C. Z. 4,743; and the third is lost sight of.

Of the original series of cotypes, the following are in the Museum of Comparative Zoölogy, through gift of the Smithsonian Institution in 1874:

M. C. Z. 4,738, skin and rostrum (formerly U. S. N. M. 3,240). Montana, Yellowstone River, below Powder River. Dr. F. V. Hayden.

M. C. Z. 4,739, skin and skull (formerly U. S. N. M. 9,664). Wyoming, North Platte. 24 August 1870. H. D. Schmidt.

M. C. Z. 4,740, skin (formerly U. S. N. M. 9,689). Wyoming, Bitter Creek. 16 October 1874. H. D. Schmidt.

M. C. Z. 4,742, skin (formerly U. S. N. M. 9,671). Wyoming, Green River. 11 September 1870. H. D. Schmidt.

M. C. Z. 4,743, skin and parts of skull (formerly U. S. N. M. 11,657). Montana, Camp Thorne, near present town of Glendive. 18 July 1873. J. A. Allen.

M. C. Z. 4,744, skin (formerly U. S. N. M. 9,682). Wyoming, Henry's Fork of Green River. 6 October 1874. H. D. Schmidt.
= *Eutamias minimus pallidus* (J. A. Allen).

Tamias striatus venustus Bangs

Proc. Biol. Soc. Washington, **10**, p. 137, 28 December 1896.

Holotype.— Male, skin and skull, 5,478 (E. A. and O. Bangs Coll.). Oklahoma, Adair County, Stilwell. 13 August 1896. Thaddeus Surber.

Petauristidae

Sciuropterus alpinus bangsi Rhoads

Proc. Acad. Nat. Sci. Philadelphia, p. 321, footnote, June 1897.

Holotype.— Male, skin and skull, 6,959 (E. A. and O. Bangs Coll.). Idaho, Idaho County. 8 March 1897. Harbison and Bargamin.
= *Glaucomys sabrinus bangsi* (Rhoads).

Sciuropterus alpinus lascivus Bangs

Proc. New England Zoöl. Club, **1**, p. 69, 31 July 1899.

Holotype.— Female, skin and skull, 9,186 (E. A. and O. Bangs Coll.). California, Eldorado County, Tallac. 28 August 1898. W. W. Price and P. O. Simons.
= *Glaucomys sabrinus lascivus* Bangs.

Sciuropterus sabrinus makkovikensis Sornborger

Ottawa Naturalist, **14**, p. 48, June 1900.

Cotypes.— Skins and skulls, M. C. Z. 10,476, 10,477, 10,478. Labrador peninsula, Makkovik. 1899. Rev. W. W. Perrett.
= *Glaucomys sabrinus makkovikensis* (Sornborger).

Sciuropterus silus Bangs

Proc. Biol. Soc. Washington, **10**, p. 163, text-fig. 29, pl. 10, fig. 6, 28 December 1896.

Holotype.— Male, skin and skull, 4,931 (E. A. and O. Bangs Coll.). West Virginia, White Sulphur Springs, top of Katis Mountain. 2 September 1895. Thaddeus Surber.
= *Glaucomys volans volans* (Linné).

Sciuropterus volans querceti Bangs

Proc. Biol. Soc. Washington, **10**, p. 166, text-fig. 32, pl. 10, fig. 4, 28 December 1896.

Holotype.— Female, skin and skull, 2,451 (E. A. and O. Bangs Coll.). Florida, Citrus County, Citronelle. 17 September 1894. F. L. Small.
= *Glaucomys volans querceti* (Bangs).

Geomyidae

Geomys colonus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 178, figs., March 1898.

Holotype.— Male, skin and skull, 5,001 (E. A. and O. Bangs Coll.). Georgia, St. Mary's. 21 March 1896. Outram Bangs.

Geomys cumberlandius Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 180, fig., March 1898.

Holotype.— Male, skin and skull, 5,015 (E. A. and O. Bangs Coll.). Georgia, Cumberland Island, "Stafford Place." 17 April 1896. Outram Bangs.

Geomys floridanus austrinus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 177, March 1898.

Holotype.— Male, skin and skull, 6,983 (E. A. and O. Bangs Coll.). Florida, Hillsboro County, Belleair. 3 August 1897. W. S. Dickinson.

Macrogeomys cavator Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 42, figs. 24, 25, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,381. Panama, Chiriqui, Boquete, 4,800 feet. 9 March 1901. W. W. Brown, Jr.

Macrogeomys pansa Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 44, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,364. Panama, Chiriqui, Bogaba. 6 July 1901. W. W. Brown, Jr.

Heteromyidae

Dipodomys californicus pallidulus Bangs

Proc. New England Zoöl. Club, **1**, p. 65, 31 July 1899.

Holotype.— Female, skin and skull, 9,147 (E. A. and O. Bangs Coll.). California, Colusa County, Sites. 27 June 1896. P. O. Simons.
= *Dipodomys heermanni californicus* Merriam.

Dipodops ordii palmeri J. A. Allen

Bull. Amer. Mus. Nat. Hist., **3**, p. 276, 30 June 1891.

Cotypes.— Skins and skulls, M. C. Z. 5,886, 5,887. Mexico, San Luis Potosi. 1 May and 10 March 1878. Edward Palmer, M.D.
= *Dipodomys ordii palmeri* (J. A. Allen).

Heteromys repens Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 45, fig. 27, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,356. Panama, Chiriqui, Boquete, 4,000 feet. 8 April 1901. W. W. Brown, Jr.

Heteromys irroratus alleni Coues

In J. A. Allen, Bull. Mus. Comp. Zoöl., **8**, p. 187, March 1881.

Holotype.— Skin and skull, M. C. Z. 5,889. Mexico, San Luis Potosi, Rio Verde, Hacienda Angostura. 26 February 1878. Edward Palmer, M.D.
= *Liomys irroratus alleni* (Coues).

Perognathus longimembris bangsi Mearns

Bull. Amer. Mus. Nat. Hist., **10**, p. 300, 31 August 1898.

Holotype.— Female, skin and skull, 5,304 (E. A. and O. Bangs Coll.). California, Riverside County, Colorado Desert, Palm Springs. 13 April 1896. E. C. Thurber.

Castoridae

Castor caecator Bangs

Bull. Mus. Comp. Zoöl., **54**, p. 513, fig., July 1913.

Holotype.— Male, skull, 6,979 (E. A. and O. Bangs Coll.). Newfoundland, near Bay St. George. 1896. Ernest Doane.

† Chalicomys eseri H. von Meyer

Jahreshefte d. Ver. f. vaterländ. Naturk. in Württemberg, Stuttgart, **2**, p. 147, pl. 3, fig. 1, a, b, 1846.

Germany, Ulm, freshwater limestone of the Oerlinger Valley. Eser Collection.

A fragment of the lower jaw, with four molariform teeth in place was the holotype. A specimen in the Eser Collection, now M. C. Z. 9,327, marked "Bestimt u. gezeichnet von Herm. v. Meyer," is probably the same. It agrees very well with the fragment figured, except that the last molar is missing and the specimen itself seems to have had the matrix (in which it was figured) quite removed from the lower part of the jaw. The reference usually cited for the original description — Jahrb. f. Mineral. 1846, p. 474 — merely gives the name without diagnosis.

Cricetidae

Akodon teguina apricus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 40, figs. 20, 21, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,236. Panama, Chiriqui, Boquete, 4,000 feet. 24 February 1901. W. W. Brown, Jr.
= *Scotinomys teguina apricus* (Bangs).

Akodon xerampelinus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 41, figs. 22, 23, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,240. Panama, Chiriqui, Volcan de Chiriqui, 10,300 feet. 26 May 1901. W. W. Brown, Jr.
= *Scotinomys xerampelinus* (Bangs).

Arvicola breweri Baird

Mammals of N. America, p. 525, 1857.

Cotype.— In alcohol, M. C. Z. 4,365 (formerly U. S. N. M. 2,833), an immature specimen lacking more or less of the fur but otherwise in good condition. Massachusetts, Muskeget Island. July 1856. Dr. Thomas M. Brewer. Gift of Smithsonian Institution, April, 1873.

Note.— Of the six specimens on which Baird founded this species, four are in the United States National Museum; the above cotype is one of the two which Lyon and Osgood state "cannot now be found."
= *Microtus breweri* (Baird).

Arvicola riparia var. longipilis Baird

Mammals of N. America, pp. 522, 524, 1857.

Cotype.— Skin and skull, M. C. Z. 5,292 (formerly U. S. N. M. 745). Illinois, West Northfield. Spring, 1855. Robert Kennicott. From Smithsonian Institution.

Note.— Baird proposed the name "var. *longipilis*" for the "Long-haired Meadowmouse" of Kennicott (Rept. U. S. Commissioner of Patents for 1856, p. 104, pl. 13, 1857) in case it should prove separable from typical *Arvicola riparia* (= *Microtus pennsylvanicus*). Baird's specimens were taken by Kennicott at West Northfield, Ill., and by Hoy at Racine, Wisconsin. Although no individuals are mentioned, the above specimen was undoubtedly among those examined by Baird in preparing his diagnosis and, therefore, is a cotype. Its tail is imperfect, but it has been made over into an excellent study specimen.

= *Microtus pennsylvanicus pennsylvanicus* (Ord).

Arvicola terraenovae Bangs

Proc. Biol. Soc. Washington, **9**, p. 129, pl. 2, 27 July 1894.

Holotype.— Male, skin and skull, 1,104 (E. A. and O. Bangs Coll.). Newfoundland, Codroy. 27 November 1893. Ernest Doane.

= *Microtus terraenovae* (Bangs).

Cansumys canus G. M. Allen

Journ. Mammalogy, **9**, p. 245, August 1928.

Holotype and genotype.— Adult female, skin and skull, M. C. Z. 23,779. China, southern Kansu, Choni. 9 December 1925. Robert B. Ekvall.

Craseomys aquilus G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 216, figs. E, F, August 1912.

Holotype.— Male, skin and skull, M. C. Z. 7,190. China, Hupeh, Showlungtan. 17 May 1907. W. R. Zappey.

= *Caryomys aquilus* (G. M. Allen).

Dicrostonyx chionopaes G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 62, 9 April 1914.

Holotype.— Male, skin and skull, M. C. Z. 15,263. Northeastern Siberia, Nijni Kolymsk, near mouth of Kolyma River. 15 October 1911. Johan Koren.

Dicrostonyx exsul G. M. Allen

Bull. Mus. Comp. Zoöl., **62**, p. 532, 27 February 1919.

Holotype.— Male, skin and skull, M. C. Z. 11,885. St. Lawrence Island, Bering Sea. 24 June 1913. Joseph Dixon.

Evotomys proteus Bangs

In Bailey, Proc. Biol. Soc. Washington, **11**, p. 137, 13 May 1897.

Holotype.— Female, skin and skull, 4,081 (E. A. and O. Bangs Coll.). Labrador, Hamilton Inlet. 27 August 1895. C. H. Goldthwaite.
= *Clethrionomys gapperi proteus* (Bangs).

Fiber obscurus Bangs

Proc. Biol. Soc. Washington, **9**, p. 133, 15 September 1894.

Holotype.— Female, skin and skull, 1,155 (E. A. and O. Bangs Coll.). Newfoundland, Codroy. 14 May 1894. Ernest Doane.
= *Ondatra obscura* (Bangs).

Fiber zibethicus aquilonius Bangs

Proc. New England Zoöl. Club, **1**, p. 11, 28 February 1899.

Holotype.— Male, skin and skull, 3,957 (E. A. and O. Bangs Coll.). Labrador, Hamilton Inlet, Rigoulette. 15 August 1895. C. H. Goldthwaite.
= *Ondatra zibethica aquilonia* (Bangs).

Fiber zibethicus rivalicius Bangs

Proc. Boston Soc. Nat. Hist., **26**, p. 541, 31 July 1895.

Holotype.— Male, skin and skull, 2,719 (E. A. and O. Bangs Coll.). Louisiana, Plaquemines Parish, Burbridge. 31 January 1895. F. L. Small.
= *Ondatra rivalicia* (Bangs).

Hesperomys eremicus Baird

Mammals of N. America, p. 479, 1857.

The following cotypes are in the collection:

M. C. Z. 4,310, in alcohol (formerly U. S. N. M. 2,574). California, Fort Yuma. G. H. Thomas. Gift of Smithsonian Institution, April 1873.

M. C. Z. 5,273, skin and skull (formerly U. S. N. M. 1,336). California, Colorado bottom. A. Schott. Gift of Smithsonian Institution. (The skin has been made over and skull removed.)

Note.— Baird's description was based on three specimens from Fort Yuma, Arizona, and three from Colorado bottom, California, no one of which was specially mentioned as a type. Though all are therefore strictly cotypes, Lyon and Osgood have argued that since "much of the description is based upon details of the soles of the feet, which could be made out more readily in alcoholic specimens" and since two of the Fort Yuma specimens were in alcohol, while the others were skins, it seems better to restrict the cotypes to the three from Fort Yuma, a definite locality, and to consider those from Colorado bottom as paratypes.

= *Peromyscus eremicus eremicus* (Baird).

Hesperomys gossypinus LeConte

Proc. Acad. Nat. Sci. Philadelphia, **6**, p. 411, 1854 (?).

Holotype or cotype.— Male, skin and skull, M. C. Z. 5,275, received from Smithsonian Institution, February 1876, where it was originally catalogued as 546. Skin made over and skull removed, 1917. Georgia (type locality presumed to be the LeConte plantation at Riceboro). 13 September 1847. Major John LeConte.

Note.— Writing of this specimen, Lyon and Osgood (1909) say that it "cannot now be found" in the United States National Museum, but that since U. S. N. M. 4,704, received later from Le Conte, is the only one of his original specimens extant in the United States National Museum, "this is perhaps well to be treated as a cotype." No. 546 (U. S. N. M. = M. C. Z. 5,275), however, "is the only specimen from Georgia listed in Baird's Mammals of North America" and its measurements on the original label agree more nearly with those of the original description than do those of any other of Le Conte's specimens received by the United States National Museum ("[head and] body $4\frac{1}{2}$, tail $2\frac{7}{12}$ in.," against 4.5 and 3 inches respectively in the original description). This specimen, therefore, seems equally entitled to be considered a cotype if not the holotype.

= *Peromyscus gossypinus gossypinus* (LeConte).

Hesperomys leucopus arcticus Mearns

Bull. Amer. Mus. Nat. Hist., **2**, p. 285, February 1890 (not of Coues, 1877) = *nomen nudum*. Proc. Biol. Soc. Washington, **24**, pp. 101, 102, 15 May 1911.

Holotype.— Male, skin and skull, M. C. Z. 5,555 (formerly U.S.N.M. 4,531). Canada, Mackenzie, Fort Simpson. 7 September 1859. Robert Kennicott.

= *Peromyscus maniculatus borealis* Mearns.

Hypudaeus nivicola Schinz

Syst. Verzeichniss aller bis jetzt bekannten Säugethiere oder Synopsis Mammalium, **2**, p. 236, 1845.

Probable cotype, skin and skull, M. C. Z. 1,290. Swiss Alps.

Note.— This specimen was received many years ago through Louis Agassiz. The original label bears the following, in a stereotyped German handwriting: "Hypodaeus nivicola juv. ♀ sp. nov. du St. Gotthard et du Faulhorn. Annales des sciences naturelles 1843." In a footnote to the original description, Schinz says that Wagner's *Hypudaeus alpinus*, a name he includes in the synonymy of *nivicola*, is unrecognizable; Martins' *Arvicola nivalis*, to which the reference on the label applies, is, however, accompanied by a good figure. In setting up the name *nivicola*, Schinz sweeps aside the two synonyms, and bases his description on a series of "16 junge und alte." Since Louis Agassiz was for two years a student of Schinz's, and in view of the likelihood that this was one of the 16 specimens above mentioned, and probably given to Agassiz by Schinz, it seems reasonable to consider it a cotype.

= *Microtus* (*Chionomys*) *nivalis* (Martins).

Lemmus paulus G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 60, 9 April 1914.

Holotype.— Male, skin and skull, M. C. Z. 15,268. Northeastern Siberia, Kalaschowo, near mouth of Kolyma River. 22 June 1912. Johan Koren.

Megadontomys flavidus Bangs.

Bull. Mus. Comp. Zoöl., **39**, p. 27, figs. 5–7, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,331. Panama, Chiriqui, Boquete, 4,000 feet. 12 April 1901. W. W. Brown, Jr.

= *Peromyscus flavidus* (Bangs).

Microtus (Eothenomys) aurora G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 211, figs. A, B, August 1912.

Holotype.— Male, skin and skull, M. C. Z. 7,788. China, Hupeh, Changyanghsien. 2 February 1909. Walter R. Zappey.

Microtus chrotorrhinus ravus Bangs

Proc. Biol. Soc. Washington, **12**, p. 188, 16 November 1898.

Holotype.— Male, skin and skull, 7,951 (E. A. and O. Bangs Coll.). Labrador, Strait of Belle Isle, Black Bay. 15 July 1898. Ernest Doane.

Microtus enixus Bangs

Amer. Nat., **30**, p. 1051, 1 December 1896.

Holotype.— Female, skin and skull, 3,973 (E. A. and O. Bangs Coll.). Labrador, Hamilton Inlet. 15 July 1895. C. H. Goldthwaite.

Microtus fontigenus Bangs

Proc. Biol. Soc. Washington, **10**, p. 48, 9 March 1896.

Holotype.— Female, skin and skull, 3,837 (E. A. and O. Bangs Coll.). Quebec, Lake Edward. 28 September 1895. E. A. and O. Bangs.
= *Microtus pennsylvanicus fontigenus* Bangs.

Microtus koreni G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 64, 9 April 1914.

Holotype.— Female, skin and skull, M. C. Z. 15,213. Northeastern Siberia, Nijni Kolymsk, near mouth of Kolyma River. 1 November 1911. Johan Koren.

Microtus (Eothenomys) mucronatus G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 214, figs. C, D, August 1912.

Holotype.— Female, skin and skull, M. C. Z. 7,789. China, western Szechwan, Tachiao, 12,000 feet. 11 August 1908. Walter R. Zappey.

Microtus pennsilvanicus (sic) shattucki Howe

Proc. Portland Soc. Nat. Hist., **2**, p. 201, 31 December 1901.

Holotype.— Female, skin and skull, M. C. Z. 10,011. Maine, Penobscot Bay, Tumble Down Dick Island. 10 July 1900. R. Heber Howe, Jr., and George C. Shattuck.
= *Microtus pennsylvanicus pennsylvanicus* Ord.

Microtus pennsylvanicus acadicus Bangs

Amer. Nat., **31**, p. 239, 1 March 1897.

Holotype.— Female, skin and skull, 2,155 (E. A. and O. Bangs Coll.). Nova Scotia, Digby. 22 July 1894. Outram Bangs.

Microtus provectus Bangs

Proc. New England Zoöl. Club, **4**, p. 20, 6 March 1908.

Holotype.— Female, skin and skull, 9,794 (E. A. and O. Bangs Coll.). Rhode Island, Block Island. 5 August 1899. Outram Bangs.

Mus bairdii Hoy and Kennicott

Rept. U. S. Commissioner of Patents for 1856, Agriculture, p. 92, pl. 11, July 1857.

Cotype.— Skin and skull, M. C. Z. 8,073 (formerly U. S. N. M. 650). Illinois, West Northfield. 15 April 1855. Robert Kennicott. From Smithsonian Institution.

Note.— No type is specified in the original description but the above specimen, collected by Kennicott at the type locality, agrees in measurements very well with the second specimen he mentions, and is one of the two skins listed by Baird in Mammals of North America, 1857, p. 478. It should, no doubt, be considered a cotype. Four alcoholic specimens in the Museum (4,340–4,343), also taken by Kennicott at West Northfield, Illinois, were probably not collected prior to 1857 as indicated by their original (Smithsonian Institution) numbers.

= *Peromyscus maniculatus bairdi* (Hoy and Kennicott)

Myopus thayeri G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 58, 9 April 1914.

Holotype.— Male, skin and skull, M. C. Z. 15,264. Northeastern Siberia, Nijni Kolymsk, near mouth of Kolyma River. 28 March 1912. Johan Koren.

Neotoma abbreviata Goldman

Proc. Biol. Soc. Washington, **22**, p. 140, 25 June 1909.

Holotype.— Male, skin and skull, M. C. Z. 12,260. Mexico, Lower California, San Francisco Island. 22 February 1909. W. W. Brown, Jr.

Neotoma bella Bangs

Proc. New England Zoöl. Club, **1**, p. 66, 31 July 1899.

Holotype.— Male, skin and skull, 5,308 (E. A. and O. Bangs Coll.). California, Riverside County, Palm Springs. 12 April 1896. E. C. Thurber.

= *Neotoma desertorum* Merriam.

Neotoma distincta Bangs

Proc. Biol. Soc. Washington, **16**, p. 89, 25 June 1903.

Holotype.— Male, skin and skull, 9,819 (E. A. and O. Bangs Coll.). Mexico, Vera Cruz, Texolo. 8 March 1899. S. N. Rhoads.

Neotoma floridana rubida Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 185, March 1898.

Holotype.— Male, skin and skull, 2,872 (E. A. and O. Bangs Coll.). Louisiana, Terrebonne Parish, Gibson. 4 April 1895. F. L. Small.

Neotoma fuscipes Baird

Mammals of N. America, p. 495, 1857 (apud Cooper MS.).

Of the five specimens on which Baird founded this species, the following are in the collection:

M. C. Z. 4,336, cotype, in alcohol. California, Petaluma. February 1856. E. Samuels. From Smithsonian Institution, 1873 (formerly U. S. N. M. 2,680).

M. C. Z. 5,264, cotype, skin. California, Santa Clara County. November 1855. J. G. Cooper. From Smithsonian Institution, 1873 (formerly U. S. N. M. 1,159).

Note.— No type is specified in the original description, which is based on five specimens. Most of the account, however, is drawn from U. S. N. M. 2,679 from Petaluma, which, for this reason, Lyon and Osgood have regarded as "the type" — now a prepared skeleton, U. S. N. M. 22,026. While strictly all five specimens are cotypes, the above two would, according to these authors, become paratypes.

= *Neotoma fuscipes annectens* Elliot.

Nyctomys nitellinus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 30, figs. 11, 12, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,249. Panama, Chiriqui, Boquete, 4,000 feet. 8 February 1901. W. W. Brown, Jr.

= *Nyctomys sumichrasti nitellinus* Bangs.

Oecomys trabeatus G. M. Allen and T. Barbour

Bull. Mus. Comp. Zoöl., **65**, p. 262, 26 February 1923.

Holotype.— Adult male, skin and skull, M. C. Z. 19,837. Eastern Panama, Rio Jesusito. 10 April 1922. Thomas Barbour and W. Sprague Brooks.

Oryzomys devius Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 34, figs. 13, 14, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,324. Panama, Chiriqui, Boquete, 5,000 feet. 29 January 1901. W. W. Brown, Jr.

Oryzomys flavicans illectus Bangs

Proc. Biol. Soc. Washington, **12**, p. 164, 10 August 1898.

Holotype.— Male, skin and skull, 8,101 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Pueblo Viejo, 8,000 feet. 24 March 1898. W. W. Brown, Jr.

Oryzomys (Erioryzomys) monochromos Bangs

Proc. New England Zoöl. Club, **1**, p. 97, 23 February 1900.

Holotype.— Male, skin and skull, 8,348 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Paramo de Macotama, 11,000 feet. 7 March 1899. W. W. Brown, Jr.
= *Thomasomys monochromos* (Bangs).

Oryzomys navus Bangs

Proc. Biol. Soc. Washington, **13**, p. 9, 31 January 1899.

Holotype.— Male, skin and skull, 8,107 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Pueblo Viejo, 8,000 feet. 26 March 1898. W. W. Brown, Jr.

Oryzomys palustris coloratus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 189, March 1898.

Holotype.— Male, skin and skull, 4,470 (E. A. and O. Bangs Coll.). Florida, Cape Sable. 17 April 1895. C. L. Brownell.

Oryzomys (Oligoryzomys) vegetus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 35, fig. 15, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,298. Panama, Chiriqui, Boquete, 4,000 feet. 16 April 1901. W. W. Brown, Jr.
= *Oryzomys fulvescens vegetus* Bangs.

Peromyscus anastasae Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 195, March 1898.

Holotype.— Female, skin and skull, 7,179 (E. A. and O. Bangs Coll.). Florida, Anastasia Island, Point Romo. 15 February 1897. Outram Bangs.

= *Peromyscus gossypinus anastasae* Bangs.

Peromyscus bellus Bangs

Proc. Biol. Soc. Washington, **10**, p. 137, 28 December 1896.

Holotype.— Female, skin and skull, 5,483 (E. A. and O. Bangs Coll.). Oklahoma, Adair County, Stilwell. 15 August 1896. Thaddeus Surber.

= *Peromyscus boylii attwateri* J. A. Allen.

Peromyscus cacabatus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 29, figs. 8–10, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,225. Panama, Chiriqui, Boquete, 5,000 feet. 22 April 1901. W. W. Brown, Jr.

= *Peromyscus nudipes* (J. A. Allen).

Peromyscus canadensis abietorum Bangs

Proc. Biol. Soc. Washington, **10**, p. 49, 9 March 1896.

Holotype.— Female, skin and skull, 2,205 (E. A. and O. Bangs Coll.). Nova Scotia, James River. 8 August 1894. C. H. Goldthwaite.

= *Peromyscus maniculatus abietorum* Bangs.

Peromyscus crinitus scitulus Bangs

Proc. New England Zoöl. Club, **1**, p. 67, 31 July 1899.

Holotype.— Male, skin and skull, 9,175 (E. A. and O. Bangs Coll.). Nevada, Douglas County, Gardnerville. 13 July 1898. W. W. Price and P. O. Simons.

= *Peromyscus crinitus crinitus* (Merriam).

Peromyscus gossypinus nigriculus Bangs

Proc. Biol. Soc. Washington, **10**, p. 124, 5 November 1896.

Holotype.— Female, skin and skull, 2,731 (E. A. and O. Bangs Coll.). Louisiana, Plaquemines Parish, Burbridge. 30 January 1895. F. L. Small.

= *Peromyscus gossypinus gossypinus* (Le Conte).

Peromyscus gossypinus palmarius Bangs

Proc. Biol. Soc. Washington, **10**, p. 124, 5 November 1896.

Holotype.— Female, skin and skull, 3,224 (E. A. and O. Bangs Coll.). Florida, Brevard County, Oak Lodge, on east peninsula opposite Micco. 23 February 1895. Outram Bangs.

Peromyscus insulanus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 196, March 1898.

Holotype.— Male, skin and skull, 6,438 (E. A. and O. Bangs Coll.). Georgia, Cumberland Island. 10 April 1897. W. W. Brown, Jr.
= *Peromyscus gossypinus anastasae* Bangs.

Peromyscus leucopus ammodytes Bangs

Proc. New England Zoöl. Club, **4**, p. 14, 28 February 1905.

Holotype.— Male, skin and skull, 828 (E. A. and O. Bangs Coll.). Massachusetts, Monomoy Island. 28 December 1893. Outram Bangs.

Peromyscus leucopus fusus Bangs

Proc. New England Zoöl. Club, **4**, p. 13, 28 February 1905.

Holotype.— Male, skin and skull 9,737 (E. A. and O. Bangs Coll.). Massachusetts, Marthas Vineyard, West Tisbury. 17 June 1899. Outram Bangs.

Peromyscus oreas Bangs

Proc. Biol. Soc. Washington, **12**, p. 84, 24 March 1898.

Holotype.— Female, skin and skull, 3,696 (E. A. and O. Bangs Coll.). British Columbia, 49th parallel, Mt. Baker Range, 6,500 feet. 29 August 1896. Allan C. Brooks.
= *Peromyscus maniculatus oreas* Bangs.

Peromyscus phasma Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 199, March 1898.

Holotype.— Female, skin and skull, 7,175 (E. A. and O. Bangs Coll.). Florida, Anastasia Island, Point Romo. 15 February 1897. Outram Bangs.
= *Peromyscus polionotus phasma* Bangs.

Peromyscus subgriseus baliolus Bangs

Peromyscus subgriseus arenarius Bangs, Proc. Boston Soc. Nat. Hist., **28**, p. 202, March 1898 (not *P. eremicus arenarius* Mearns, 1896); renamed in Science, new ser., **8**, p. 215, 19 August 1898.

Holotype.— Male, skin and skull, 5,925 (E. A. and O. Bangs Coll.). Georgia, Scriven County, Hursman's Lake (Savannah River), near Bascom. 15 December 1896. W. W. Brown, Jr.

= *Peromyscus polionotus polionotus* (Wagner).

Peromyscus subgriseus rhoadsi Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 201, March 1898.

Holotype.— Male, skin and skull, 6,980 (E. A. and O. Bangs Coll.). Florida, Hillsboro County, head of Anclote River. 23 May 1895. W. S. Dickinson.

= *Peromyscus polionotus rhoadsi* Bangs.

Peromyscus texanus saturatus Bangs

Amer. Nat., **31**, p. 75, 1 January 1897.

Holotype.— Male, skin and skull, 2,581 (E. A. and O. Bangs Coll.). British Columbia, Saturna Island. 31 January 1894. W. C. Colt.

= *Peromyscus maniculatus saturatus* Bangs.

Phenacomys celatus crassus Bangs

Proc. New England Zoöl. Club, **2**, p. 39, 20 September 1900.

Holotype.— Male, skin and skull, 3,959 (E. A. and O. Bangs Coll.). Labrador, Hamilton Inlet, Rigoulette. 15 August 1895. C. H. Goldthwaite.

= *Phenacomys ungava crassus* Bangs.

Reithrodontomys australis vulcanius Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 38, figs. 16, 17, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,281. Panama, Chiriqui, Volcan de Chiriqui, 10,300 feet. 26 May 1901. W. W. Brown, Jr.

= *Reithrodontomys australis australis* J. A. Allen.

Reithrodontomys creper Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 39, figs. 18, 19, April 1902.

Holotype.— Female, skin and skull, M. C. Z. 10,284. Panama, Chiriqui, Volcan de Chiriqui, 11,000 feet. 2 June 1901. W. W. Brown, Jr.

Reithrodontomys lecontii impiger Bangs

Proc. Biol. Soc. Washington, **12**, p. 167, 10 August 1898.

Holotype.— Male, skin and skull, 7,784 (E. A. and O. Bangs Coll.). West Virginia, White Sulphur Springs. 27 February 1898. Thaddeus Surber.

= *Reithrodontomys humulis impiger* Bangs.

Sigmodon austerulus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 32, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,288. Panama, Chiriqui, Volcan de Chiriqui, 10,000 feet. 1 June 1901. W. W. Brown, Jr.

Sigmodon hispidus exsputus G. M. Allen

Journ. Mammalogy, **1**, p. 236, 4 December 1920.

Holotype.— Adult male, skin and skull, M. C. Z. 18,100. Big Pine Key, Florida. 16 April 1920. W. Sprague Brooks.

Sigmodon hispidus fervidus Lydekker

Zoöl. Record for 1903, **40**, Mammalia, p. 34, 1904.

Holotype.— Male, skin and skull, M. C. Z. 10,665. Honduras, Ceiba. 16 January 1902. W. W. Brown, Jr.

= *Sigmodon hispidus furvus* Bangs (accidental renaming).

Sigmodon hispidus furvus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 158, July 1903.

Holotype.— Male, skin and skull, M. C. Z. 10,665. Honduras, Ceiba. 16 January 1902. W. W. Brown, Jr.

Sigmodon hispidus spadicipygus Bangs

Proc. Boston Soc. Nat. Hist., **28**, p. 192, March 1898.

Holotype.— Female, skin and skull, 4,477 (E. A. and O. Bangs Coll.). Florida, Cape Sable. 18 April 1895. C. L. Brownell.

Sigmodon sanctae-martae Bangs

Proc. Biol. Soc. Washington, **12**, p. 189, 30 December 1898.

Holotype.— Male, skin and skull, 8,105 (E. A. and O. Bangs Coll.). Colombia, Santa Marta Mountains, Pueblo Viejo, 8,000 feet. 23 March 1898. W. W. Brown, Jr.

Synaptomys fatuus Bangs

Proc. Biol. Soc. Washington, **10**, p. 47, 9 March 1896.

Holotype.— Female, skin and skull, 3,857 (E. A. and O. Bangs Coll.). Quebec, Lake Edward. 28 September 1895. E. A. and O. Bangs.
= *Synaptomys cooperi cooperi* Baird.

Synaptomys (Mictomys) innuitus medioximus Bangs

Proc. New England Zoöl. Club, **2**, p. 40, 20 September 1900.

Holotype.— Male, skin and skull, 8,852 (E. A. and O. Bangs Coll.). Labrador, Lance au Loup. 15 April 1899. Ernest Doane.
= *Synaptomys borealis medioximus* Bangs.

Zygodontomys seorsus Bangs

Amer. Nat., **35**, p. 642, August 1901.

Holotype.— Male, skin and skull, 8,490 (E. A. and O. Bangs Coll.). Panama Bay, San Miguel Island. 5 May 1900. W. W. Brown, Jr.

Muridae

Apodemus mystacinus euxinus G. M. Allen

Bull. Mus. Comp. Zoöl., **59**, p. 11, February 1915.

Holotype.— Male, skin and skull, M. C. Z. 14,887. Asia Minor, Scalita (near Trebizond). 25 November 1905. A. Robert.

Epimys zappeyi G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 225, August 1912.

Holotype.— Male, skin and skull, M. C. Z. 7,607. China, Szechwan, Washan Mountains. 26 October 1908. Walter R. Zappey.
= *Rattus excelsior zappeyi* (G. M. Allen).

Hylomyscus alleni simus G. M. Allen and H. J. Coolidge, Jr.

In R. P. Strong's The African Republic of Liberia (Cambridge, Mass.), **2**, p. 599, October 1930.

Holotype.— Male, skin and skull, M. C. Z. 24,028. Liberia, Merikay. 13 September 1926. G. M. Allen and H. J. Coolidge, Jr.

Tatera flavipes G. M. Allen

Bull. Mus. Comp. Zoöl., **58**, p. 331, fig. 2, July 1914.

Holotype.— Female, skin and skull, M. C. Z. 14,491. Sudan, Blue Nile, Aradeiba, above Roseires. 22 January 1913. J. C. Phillips' Sudan Expedition.

Tatera soror G. M. Allen

Bull. Mus. Comp. Zoöl., **58**, p. 333, fig. 3, July 1914.

Holotype.— Female, skin and skull, M. C. Z. 14,492. Sudan, Blue Nile, Fazogli. 16 January 1913. J. C. Phillips' Sudan Expedition.

Taterillus melanops G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 446, April 1912.

Holotype.— Male, skin and skull, M. C. Z. 8,132. Kenya Colony, Meru River, an affluent of the northern Guaso Nyiro. 11 August 1909. G. M. Allen.

Thamnomys ochraceus G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 442, April 1912.

Holotype.— Male, skin and skull, M. C. Z. 8,126. Kenya Colony, Meru River near its junction with northern Guaso Nyiro. 8 August 1909. G. M. Allen.
= *Thamnomys macmillani ochraceus* G. M. Allen.

Aplodontiidae

Aplodontia californica columbiana Taylor

Univ. of California Publ., Zoöl., **12**, p. 499, 6 May 1916.

Holotype.— Skin and skull, 1,899 (E. A. and O. Bangs Coll.). British Columbia, Hope, Roab's Ranch. 14 June 1894. W. C. Colt.
= *Aplodontia rufa columbiana* Taylor.

Zapodidae

Zapus hudsonius ladas Bangs

Proc. New England Zoöl. Club, **1**, p. 10, 28 February 1899.

Holotype.— Female, skin and skull, 4,169 (E. A. and O. Bangs Coll.). Labrador, Hamilton Inlet, Rigoulette. 18 July 1895. C. H. Goldthwaite.

Zapus orarius Preble

N. American Fauna (U. S. Dept. Agric., Biol. Surv.), no. 15, p. 29, 8 August 1899.

Holotype.— Male, skin and skull, 250 (E. A. and O. Bangs Coll.). California, Marin County, Point Reyes. 14 May 1893. Charles A. Allen.

Pedetidae

Pedetes cafer taborae G. M. Allen and A. Loveridge

Proc. Boston Soc. Nat. Hist., **38**, p. 438, 19 December 1927.

Holotype.— Adult female, skin and skull, M. C. Z. 23,080. Tanganyika Territory, Tabora. 18 November 1921. Arthur Loveridge.

Bathyergidae

Heterocephalus stygius G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 444, April 1912.

Holotype.— Female in alcohol and dry skull, M. C. Z. 12,470. Kenya Colony, northern Guaso Nyiro, Neumann's Boma. 6 August 1909. G. M. Allen.
= *Heterocephalus glaber* Rüppell.

† Theridomyidae

Note.— The type specimen of *Theridomys siderolithicus* Pictet, originally in the Campiche Collection, is not now to be found. A speci-

men referred to this species by Pictet (Mat. Paléont. Suisse, 1855–57, pt. 2, pl. 6, figs. 12, 13) is M. C. Z. 5,812.

Erethizontidae

Erethizon dorsatus picinus Bangs

Proc. New England Zoöl. Club, **2**, p. 37, 20 September 1900.

Holotype.— Male, skin and skull, 8,839 (E. A. and O. Bangs Coll.). Labrador, Strait of Belle Isle, Lance [=L'Anse] au Loup. 16 February 1899. Ernest Doane.

= *Erethizon dorsatum picinum* Bangs.

Echimyidae

† Boromys torrei G. M. Allen

Bull. Mus. Comp. Zoöl., **61**, p. 6, pl., figs. 10–13, January 1917.

Holotype.— Palate with root of right zygomatic arch, two teeth in place, M. C. Z. 9,601. Cuba, Province of Matanzas, cave in Sierra de Hato Nuevo. Carlos de la Torre.

Capromys pilorides relictus G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 207, July 1911.

Holotype.— Male, skin and skull, M. C. Z. 10,996. Cuba, Isle of Pines, Nueva Gerona, Casas Mountains. 10 March 1902. W. R. Zappey.

Capromys nana G. M. Allen

Proc. New England Zoöl. Club, **6**, p. 54, 28 March 1917.

Holotype.— Right lower mandible, M. C. Z. 9,864. Cuba, Province of Matanzas, cave in Sierra de Hato Nuevo. Thomas Barbour.

† Geocapromys cubanus G. M. Allen

Bull. Mus. Comp. Zoöl., **61**, p. 9, pl., figs. 7–9, January 1917.

Holotype.— Part of right lower ramus containing incisor and three cheek-teeth, M. C. Z. 9,602. Cuba, Province of Matanzas, cave in Sierra de Hato Nuevo. Carlos de la Torre.

= † *Geocapromys columbianus* (Chapman).

Loncheres labilis Bangs

Amer. Nat., **35**, p. 638, 3 figs., August 1901.

Holotype.— Male, skin and skull, 8,480 (E. A. and O. Bangs Coll.). Panama, Panama Bay, San Miguel Island. 26 April 1900. W. W. Brown, Jr.

= *Diplomys labilis* (Bangs).

Proechimys burrus Bangs

Amer. Nat., **35**, p. 640, fig., August 1901.

Holotype.— Male, skin and skull, 8,458 (E. A. and O. Bangs Coll.). Panama, Bay of Panama, San Miguel Island. 30 April 1900. W. W. Brown, Jr.

= *Proechimys semispinosus burrus* Bangs.

Proechimys gorgonae Bangs

Bull. Mus. Comp. Zoöl., **46**, p. 89, June 1905.

Holotype.— Male, skin and skull, M. C. Z. 10,828. Colombia, Gorgona Island. 2 July 1904. W. W. Brown, Jr.

Dasyproctidae

Dasyprocta callida Bangs

Amer. Nat., **35**, p. 635, fig., August 1901.

Holotype.— Male, skin and skull, 8,443 (E. A. and O. Bangs Coll.). Panama, Bay of Panama, San Miguel Island. 8 May 1900. W. W. Brown, Jr.

Dasyprocta colombiana Bangs

Proc. Biol. Soc. Washington, **12**, p. 163, 10 August 1898.

Holotype.— Female, skin and skull, 8,008 (E. A. and O. Bangs Coll.). Colombia, Santa Marta. 6 January 1898. W. W. Brown, Jr.

Dasyprocta noblei G. M. Allen

Proc. New England Zoöl. Club, **5**, p. 69, 7 October 1914.

Holotype.— Female, skin and skull, M. C. Z. 15,936. West Indies, Guadeloupe Island, Goyave. 22 August 1914. G. K. Noble.

Dasyprocta punctata nuchalis Goldman

Proc. Biol. Soc. Washington, **30**, p. 113, 23 May 1917.

Holotype.— Female, skin and skull, 10,081 (E. A. and O. Bangs Coll.). Panama, Chiriqui, Divalá. 30 November 1900. W. W. Brown, Jr.

Cuniculidae

Agouti paca virgatus Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 47, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,079. Panama, Chiriqui, Divalá. 16 December 1900. W. W. Brown, Jr.
= *Cuniculus paca virgatus* (Bangs).

LAGOMORPHA

Ochotonidae

Ochotona cuppes Bangs

Proc. New England Zoöl. Club, **1**, p. 40, 5 June 1899.

Holotype.— Male, skin and skull, 7,389 (E. A. and O. Bangs Coll.). British Columbia, Gold Range, Monishee Divide, 4,000 feet. 12 August 1897. Allan C. Brooks.
= *Ochotona princeps cuppes* Bangs.

Ochotona saxatilis Bangs

Proc. New England Zoöl. Club, **1**, p. 41, 5 June 1899.

Holotype.— Male, skin, M. C. Z. 2,703. Colorado, Park County, Snowy Range, Montgomery, near limit of trees. 27 July 1871. Rocky Mountain Expedition, J. A. Allen.
= *Ochotona princeps saxatilis* Bangs.

Leporidae

Lepus (Macrotolagus) alleni palitans Bangs

Proc. New England Zoöl. Club, **1**, p. 85, 23 February 1900.

Holotype.— Female, skin and skull, 9,096 (E. A. and O. Bangs Coll.). Mexico, Sinaloa, Aguacaliente (about forty miles southeast of Mazatlan). 7 August 1897. P. O. Simons.

Lepus americanus struthopus Bangs

Proc. Biol. Soc. Washington, **12**, p. 81, 24 March 1898.

Holotype.— Female, skin and skull, 2,025 (E. A. and O. Bangs Coll.). Nova Scotia, Digby. 4 August 1894. Outram Bangs.

Lepus arcticus bangsi Rhoads

Amer. Nat., **30**, p. 236, 20 February (author's separates), 1896.

Holotype.— Female, skin and skull, 3,752 (E. A. and O. Bangs Coll.). Newfoundland, Codroy. 3 August 1895. Ernest Doane.

Lepus bairdi Hayden

Amer. Nat., **3**, p. 115, fig., May 1869.

Cotype.— Skin and skull, M. C. Z. 500 (formerly U. S. N. M. 4,264). Wyoming, summit of Wind River Mountains, near Fremont Peak. 4 June 1860. Dr. F. V. Hayden. Gift of Smithsonian Institution, May 1876.

Note.— No type was designated but the description was based on six specimens, of which three were young. Of the three adults, but one is now to be found in the United States National Museum (see Bull. U. S. Nat. Mus., no. 62, p. 27, 1909). The above specimen in white winter pelage is now made over into a good study skin and the skull, nearly perfect, has been removed and cleaned.

Lepus bairdi cascadensis Nelson

Proc. Biol. Soc. Washington, **20**, p. 87, 11 December 1907.

Holotype.— Male, skin and skull, 1,886 (E. A. and O. Bangs Coll.). British Columbia, near Hope, Roab's Ranch. 12 June 1894. W. C. Colt.

Lepus (Tapeti) incitatus Bangs

Amer. Nat., **35**, p. 633, fig., August 1901.

Holotype.— Female, skin and skull, 8,441 (E. A. and O. Bangs Coll.). Panama, Panama Bay, San Miguel Island. 30 April 1900. W. W. Brown, Jr.

= *Sylvilagus gabbi incitatus* (Bangs).

LEPUS PALUDICOLA Miller and Bangs

Proc. Biol. Soc. Washington, **9**, p. 105, 9 June 1894.

Holotype.— Female, skin and skull, 1,451 (E. A. and O. Bangs Coll.). Florida, Citrus County, Fort Island, near Crystal River. 28 January 1894. F. L. Small.
= *Sylvilagus palustris paludicola* (Miller and Bangs).

LEPUS SYLVATICUS ALACER Bangs

Proc. Biol. Soc. Washington, **10**, p. 136, 28 December 1896.

Holotype.— Female, skin and skull, 5,480 (E. A. and O. Bangs Coll.). Oklahoma, Stilwell. 14 August 1896. Thaddeus Surber.
= *Sylvilagus floridanus alacer* (Bangs).

LEPUS SYLVATICUS TRANSITIONALIS Bangs

Proc. Boston Soc. Nat. Hist., **26**, p. 405, 31 January 1895.

Holotype.— Male, skin and skull, 2,407 (E. A. and O. Bangs Coll.). Connecticut, Liberty Hill. 6 November 1894. Outram Bangs.
= *Sylvilagus transitionalis* (Bangs).

ARTIODACTYLA

† DICHOBUNIDAE

† DICHOBUNE CAMPICHII Pictet

Matériaux pour la Paléontol. Suisse, ser. 1, part 2, Mémoire sur les animaux vertébrés trouvés dans le terrain sidérolitique du canton du Vaud, part 2, p. 57, pl. 4, figs. 5–9, 1855–1857.

Holotype.— Anterior portion of lower jaws, M. C. Z. 5,465 (the tip of the right canine, shown in Pictet's figure, is now lost). Switzerland, Mauremont (Eocene). Campiche Collection.
= † *Metadichobune campichii* (Pictet).

† DICHOBUNE SUILLUM Gervais

Zoöl. et Paléont. Françaises, ed. 2, p. 94, pl. 17, figs. 11–18, and explanation, 1848–1852.

Three of the cotypes, viz. part of lower ramus with three teeth in place, M. C. Z. 4,750 (original of Gervais' fig. 11); lower molar doubtfully referred to this species, M. C. Z. 9,217(original of Gervais' fig. 16);

lower incisor, M. C. Z. 5,856 (original of Gervais' fig. 12). One incisor and two foot bones figured by Gervais and referred to this species, are not now to be found in the Duval Collection. France, Passy (Middle Eocene). Duval Collection.

Suidae

† Choeropotamus matritensis Ezquerra del Bayo

Neues Jahrb. f. Mineral., p. 221, 1840.

Cotypes.— Two upper molars, lacking roots, M. C. Z. 4,840, 4,841. Spain, near Madrid, Cerro de San Isidro. 1838–39. Ezquerra del Bayo, Bronn Coll.

Note.— As originally published, this appears to be a *nomen nudum.* It is clear, however, that the name is based on the description of the two teeth by Kaup (Neues Jahrb. f. Mineral., p. 540, 1840, with the contents of whose paper Ezquerra was evidently familiar, though the paper itself did not appear until later in the volume. H. von Meyer (ibid., 1844, p. 288) quotes the name as of Ezquerra, but though he again describes the specimens, he does not venture to regard them as representing a new species.

= † *Choeropotamus affinis* Gervais.

† Hyotherium (?) americanum Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 155, September 1887.

Cotype.— A hind foot, M. C. Z. 9,155 (comprises an astragalus, cuboid, metatarsals II–V, two proximal phalanges of mt. IV, and the proximal phalanx of mt. V). South Dakota, White River (Oligocene). 1880–81. Samuel Garman.

Note.— A skull agreeing "very closely . . . with the Hyotherium of Europe" is mentioned in the original description as being in the Princeton Museum. Although not further described here, it is to be considered the other cotype of the species.

Tayassuidae

Tayassu crusnigrum Bangs

Bull. Mus. Comp. Zoöl., **39**, p. 20, April 1902.

Holotype.— Male, skin and skull, M. C. Z. 10,163. Panama, Chiriqui, Boquete, 4,000 feet. 13 April 1901. W. W. Brown, Jr.

= *Pecari angulatus crusnigrum* (Bangs).

Tayassu torvus Bangs

Proc. Biol. Soc. Washington, **12**, p. 164, 10 August 1898.

Holotype.— Male, skin and skull, 8,038 (E. A. and O. Bangs Coll.). Colombia, Santa Marta. 26 January 1898. W. W. Brown, Jr.

= *Pecari angulatus torvus* (Bangs).

† Entelodontidae

† Dinohyus (?) mento G. M. Allen

Bull. Mus. Comp. Zoöl., **67**, p. 450, pl. 1, July 1926.

Holotype.— Anterior portion of lower jaws, teeth missing, M. C. Z. 17,015. South Carolina, phosphate deposits of Ashley River, horizon unknown. Robert Wilson Collection.

† Elotherium superbum Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 177, 1868.

Holotype.— "Right upper lateral incisor," M. C. Z. 9,564. California, Calaveras County, Douglas Flat (Miocene). J. D. Whitney Collection.

= † *Entelodon superbum* (Leidy).

† Agriochoeridae

† Merycochoerus coenopus Scott

Morph. Jahrb., **16**, p. 346, pl. 16, figs. 33, 34, 1890.

Holotype.— Manus and pes, distal end of a fibula and of an ulna, M. C. Z. 9,156. Nebraska, Loup Fork (Miocene). Samuel Garman.

Note.— The manus comprises all the carpalia, metatarsals III, IV, and V, the two proximal phalanges of digits II and IV, all three phalanges of digit III, and the proximal phalanx of digit V, right side. The pes consists of the cuboid, navicular, internal cuneiform, metatarsals II to V, the proximal phalanx of digit IV, two proximal phalanges of digit III, and the second phalanx of digit II — all of the right side. In addition there are: the astragalus, cuboid, and navicular of the left pes. All the bones are probably from one individual.

Camelidae

† Auchenia californica Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 126, November 1870.

Cotypes.— Metacarpal, M. C. Z. 9,122; a distal extremity of a metacarpal, M. C. Z. 9,123; proximal end of femur, M. C. Z. 9,124; ace-

tabulum, M. C. Z. 9,125; two fragments of tibia, M. C. Z. 9,126, 9,127. California, Merced County, near the line of Mariposa, "on a nameless dry creek tributary to Bear Creek" (not Table Mountain, Tuolumne County, see Whitney, Mem. Mus. Comp. Zoöl., **6**, p. 248, 1880). C. D. Voy.

= † *Camelops californicus* (Leidy).

Cervidae

Cariacus osceola Bangs

Proc. Biol. Soc. Washington, **10**, p. 26, 25 February 1896.

Holotype.— Female, skin and skull, 2,394 (E. A. and O. Bangs Coll.). Florida, Citrus County, Citronelle. 29 December 1893. F. L. Small.

= *Odocoileus virginianus osceola* (Bangs).

† Cervus whitneyi J. A. Allen

Amer. Journ. Sci., ser. 3, **11**, p. 48, January 1876.

Cotypes.— A left humerus lacking the head, M. C. Z. 10,985; a left radius lacking the proximal end (not *distal* end as stated in original description), M. C. Z. 10,986; a right metatarsal lacking the distal end, M. C. Z. 10,987. Iowa, Dubuque (lead crevices, Pleistocene). About 1857. J. D. Whitney.

Note.— There is nothing to indicate that these three bones appertain to the same individual or that they were found in the same locality. The locality given is that written on a general label placed with these and other bones in the Whitney Collection from the Lead Region.

= (?) † *Odocoileus whitneyi* (J. A. Allen).

Odocoelus (sic) virginianus louisianae G. M. Allen

Amer. Nat., **35**, p. 449, fig., June 1901.

Holotype.— Male, skin and skull, 9,111 (E. A. and O. Bangs Coll.). Louisiana, Morehouse Parish, Mer Rouge. 8 November 1898. B. V. Lilly.

= *Odocoileus virginianus louisianae* (G. M. Allen).

Odocoileus americanus borealis Miller

Bull. N. Y. State Mus., **8**, no. 38, p. 83, 21 November 1900 (but dated October).

Holotype.— Male, skin and skull, 4,999 (E. A. and O. Bangs Coll.). Maine, Bucksport. 12 December 1895. A. G. Dorr.

= *Odocoileus virginianus borealis* Miller.

Odocoileus virginianus clavium T. Barbour and G. M. Allen

Journ. Mammalogy, **3**, p. 73, pl. 5, fig. 4, 9 May 1922.

Holotype.— Adult male, head-skin and skull, M. C. Z. 19,120. Florida, Big Pine Key. Winter, 1920.

Rangifer arcticus caboti G. M. Allen

Proc. New England Zoöl. Club, **4**, p. 104, figs. 1–3, 24 March 1914.

Holotype.— A shed antler, M. C. Z. 15,372. Labrador, about thirty miles north of Nachvak. 1909. Owen Bryant.

Rangifer terraenovae Bangs

Preliminary Description of the Newfoundland Caribou, Boston, A. Mudge & Son, p. [2], 11 November 1896.

Holotype.— Male, skin and skull, 3,778 (E. A. and O. Bangs Coll.). Newfoundland, Codroy. 8 September 1895. Ernest Doane.

PERISSODACTYLA

† Palaeotheriidae

† Palaeotherium duvalii Pomel

Cat. Méthodique et Descr. des Vertébrés Foss. . . . de la Loire, Paris, p. 81, 1853.

Holotype.— Skeletal fragments, possibly of one individual, viz. M. C. Z. 4,799, humerus; M. C. Z. 4,800, left ramus and symphysis of jaw; M. C. Z. 4,802, proximal end of femur; M. C. Z. 4,803, distal half of tibia; M. C. Z. 4,804, anterior end of left maxillary; M. C. Z. 4,807, calcaneum; M. C. Z. 5,438, astragalus. France, "environs de Paris." Duval Collection.

Note.— Pomel bases this name directly upon the figures of Duval's specimens in Gervais' Plate 16 of Zoöl. et Paléontol. Françaises, ed. 2, 1848–52. Duval's specimens are, therefore, the types. In addition to the parts figured, the collection contains a proximal half of a tibia (M. C. Z. 4,805), the proximal end of a scapula (M. C. Z. 4,801), and part of a centrum (M. C. Z. 4,806).

= † *Palaeotherium curtum* Cuvier.

Equidae

† Anchitherium ezquerrae H. von Meyer

Neues Jahrb. f. Mineral, p. 299–305, 1844.

Cotypes.— A right lower penultimate molar, unworn, M. C. Z. 5,419; right upper penultimate molar, M. C. Z. 5,415; left upper penultimate molar, much worn, M. C. Z. 5,417; an incisor, lacking half the crown, M. C. Z. 5,420; crown of a smaller incisor, M. C. Z. 9,219; a middle phalanx, M. C. Z. 5,416; an ungual phalanx, M. C. Z. 5,418; a semilunar bone, M. C. Z. 5,421. Two other foot bones (M. C. Z. 5,422, 5,423) accompany these specimens but are not described. Spain, near Madrid, Cerro de San Isidro (upper Miocene). 1839. Ezquerra del Bayo. Bronn Collection.
= † *Anchitherium aurelianense* Cuvier.

† Equus occidentalis Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 94, June 1865.

Cotypes.— Upper premolar, second left, M. C. Z. 9,129; upper premolar, second right, M. C. Z. 9,130. California, Tuolumne County, Columbia, "from auriferous clay 20 feet below the surface" (M. C. Z. 9,129); Buena Vista Lake (M. C. Z. 9,130). J. D. Whitney.

Note.— Gidley (Bull. Amer. Mus. Nat. Hist., **14**, p. 115, 1901) selects M. C. Z. 9,129 as the type. This tooth is figured by Leidy (Rept. U. S. Geol. Surv. Terr., F. V. Hayden in charge, **1**, pl. 33, figs. 1, 2, 1873) and by Gidley (*l. c.*, p. 115, fig. 10).

† Equus pacificus Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 195, 1868.

Holotype.— Second upper molar, M. C. Z. 9,565. California, Contra Costa County, Martinez (Pleistocene). J. D. Whitney Collection.

† Hyracotherium siderolithicum Pictet

Matériaux pour la Paléontol. Suisse, ser. 1, art. 2, Mémoire sur les animaux vertébrés trouvés dans le terrain sidérolitique du canton du Vaud, part 2, p. 53, pl. 4, figs. 1–4, 1855–57.

Cotype.— Fragment of maxilla with five teeth, M. C. Z. 5,467. The other cotype, a worn molar, is not now to be found. Switzerland, Mauremont (Eocene). Campiche Collection.
= † *Lophiotherium siderolithicum* (Pictet).

† Lophiodon duvalii Pomel

Arch. des Sci. Phys. et Nat. (Suppl. à la Bibl. Universelle de Génève), **4**, p. 327, 1847.

Holotype.— Left upper molar series, M. C. Z. 5,464. France, Passy (Middle Eocene). Duval Collection.

Note.— Pomel briefly characterizes this species on the basis of "communications" from M. Duval, in whose collection was "une série complète" of upper teeth. The name has been currently credited to Gervais, who described and figured Duval's specimen (Zoöl. et Paléontol. Françaises, ed. 2, p. 56, pl. 17, figs. 1, 1a and explanation, 1848–52) and referred to it a lower molar in the Duval Collection (now M. C. Z. 5,464 *bis*) and a lower jaw figured by Blainville. Pomel's name has priority, and was evidently based on the present specimen.

= † *Pachynolophus duvalii* (Pomel).

† Brontotheriidae

† Menodus dolichoceras Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 160, figs. 3 (3), 5 (3), 6 (3), September 1887.

Holotype.— Skull, "incomplete in the supraoccipital region, the zygomatic arch . . . fragmentary," M. C. Z. 9,159. South Dakota, White River (Oligocene). Samuel Garman.

= † *Brontotherium dolichoceras* (Scott and Osborn).

† Menodus platyceras Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 160, fig. 4, September 1887.

Holotype.— A pair of horn cores with nasal bones attached, M. C. Z. 9,160. South Dakota, White River (Oligocene). Samuel Garman.

= † *Brontotherium platyceras* (Scott and Osborn).

† Menodus tichoceras Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 159, figs. 3 (2), 5 (2), 6 (2), September 1887.

Holotype.— Skull, "with the dentition complete, and lacking the upper part of the horns and the crest of the occiput," M. C. Z. 9,158. South Dakota, White River (Oligocene). Samuel Garman.

= † *Megacerops tichoceras* (Scott and Osborn).

† LOPHIODONTIDAE

† LOPHIODON PARISIENSE Gervais

Zoöl. et Paléontol. Françaises, ed. 2, p. 54, pl. 17, figs. 3–10, and explanation of pl. 18, fig. 2, 1848–52.

Cotypes.— Eight teeth figured and described by Gervais: M. C. Z. 4,757, lower canine; M. C. Z. 4,758, last upper molar; M. C. Z. 4,760, lower canine; M. C. Z. 4,761, third upper incisor; M. C. Z. 4,764, last lower molar; M. C. Z. 4,773, penultimate upper molar; M. C. Z. 4,774, last upper molar; M. C. Z. 5,766, second upper incisor. France, Passy (Middle Eocene). Duval Collection.

NOTE.— In addition to the figured specimens, the same lot (orig. no. 72) contains eleven other teeth (M. C. Z. 4,752, 4,755, 4,756, 4,762, 4,765, 4,767, 4,768, 4,770, 4,771, 4,774) and four foot bones (M. C. Z. 4,759, 4,763, 4,769, 4,772), all of which are probably to be considered cotypes.

† HYRACODONTIDAE

† HYRACODON MAJOR Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 170, September 1887.

Holotype.— A carpus and its metacarpals, M. C. Z. 11,703. ? South Dakota, White River (Oligocene). July 1880. Samuel Garman.

NOTE.— In describing this species, the authors say that the type "is a fairly complete skeleton in the Princeton Museum," which, however, is not otherwise mentioned. Their description is based wholly on the carpus and metacarpals which must, therefore, be considered the type in spite of the fact that the Princeton skeleton was so designated.

† HYRACODON (?) PLANICEPS Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 170, September 1887.

Holotype.— Skull, lacking "most of the facial portion," M. C. Z. 6,608. South Dakota, White River (Oligocene). July 1880. Samuel Garman.

† METAMYNODON PLANIFRONS Scott and Osborn

Bull. Mus. Comp. Zoöl., **13**, p. 165, figs. 7–9, September 1887.

Holotype.— Skull with anterior portion of left mandibular ramus, M. C. Z. 9,157. South Dakota, White River (Oligocene). Samuel Garman.

Rhinocerotidae

† Rhinoceros hesperius Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 177, September 1865.

Holotype.— Symphysis and dental portion of right ramus, M. C. Z. 9,118. California, Calaveras County, Chili Gulch (Miocene). J. D. Whitney Collection.
= † *Diceratherium hesperium* (Leidy).

PROBOSCIDEA

† Mastodontidae

† Mastodon simorrense Lartet

Notice sur la colline de Sansan, p. 24, 1851.

Cotype.— Upper molar series of right and left sides of same individual, M. C. Z. 9,253. France, near Sansan, Villefranche. 1848. Edouard Lartet.

Note.— No type is specified, but from the original label it is clear that the above specimen is the one mentioned in Lartet's description as having a "molaire de *remplacement à quatre mamelons,* fonctionnant simultanément avec les deux premières arrière-molaires et moins usée que celles-ci" and in which the last molar "se montre déjà en germe développé dans l'arrière de la mâchoire." It is, therefore, a cotype.
= † *Tetrabelodon angustidens* (Cuvier).

XENARTHRA

† Megalonychidae

† Megalonyx sierrensis Sinclair

Univ. California Publ., Bull. Dept. Geol., **4**, p. 155, pl. 20, figs. 5–8; pl. 21, figs. 1, 2; pl. 22, figs. 1–3, July 1905.

Part of holotype, lower jaws, M. C. Z. 14,986. California, Calaveras County, Mercer's Cave, near Murphys (Quaternary). 1887 and 1902. Z. A. Willard and W. J. Sinclair.

Note.— The species is described from the lower jaws, found in 1887 by Z. A. Willard, and from sundry other skeletal parts of the same individual discovered in 1902 by W. J. Sinclair. These latter bones are 8,130, University of California Palaeontological Collection.

† Mylodon garmani G. M. Allen

Mem. Mus. Comp. Zoöl., **40**, p. 319, pls. 1–4, September 1913.

Holotype.— Nearly perfect skull and most of the rest of the skeleton, M. C. Z. 8,429. Nebraska, Niobrara River (Pleistocene or Pliocene). 1880. Samuel Garman.

† Orycterotherium oregonensis Perkins

Boston Journ. Nat. Hist., **4**, no. 1, p. 135, 1842.

Holotype.— Humerus, M. C. Z. 9,191. Oregon, Willamette River, lat. 44° N. (Pleistocene). December 1839. Ewing Young.

Note.— This specimen was figured and described, but not named, by Perkins in Amer. Journ. Sci., ser. 1, **42**, p. 136–140, figs. 2–4, 1841. Transferred to Museum of Comparative Zoölogy by Boston Society of Natural History, 1915.

= † *Mylodon harlani* Owen.

Dasypodidae

Dasypus novemcinctus hoplites G. M. Allen

Bull. Mus. Comp. Zoöl., **54**, p. 195, July 1911.

Holotype.— Female, skin and skeleton, M. C. Z. 8,116. British West Indies, Grenada, hills back of Gouyave. 7 September 1910. G. M. Allen.

CETACEA

† Dorudontidae

† Dorudon serratus Gibbes

Proc. Acad. Nat. Sci. Philadelphia, **2**, p. 254, pl. 1, 1845.

Holotype.— Teeth and bone fragments, M. C. Z. 8,763. South Carolina, near the Santee Canal in a bed of Green Sand (Eocene). March 1845.

† Squalodontidae

† Saurocetus gibbesii L. Agassiz

Proc. Acad. Nat. Sci. Philadelphia, **4**, p. 4, 1848.

Holotype.— A tooth lacking part of the root, M. C. Z. 8,760. South Carolina, probably Ashley River phosphates (? Eocene). Louis Agassiz. For a description of the tooth see G. M. Allen, Journ. Mammalogy, **5**, p. 120, pl. 16, May 1924.

† Squalodon crassus G. M. Allen

Bull. Mus. Comp. Zoöl., **67**, p. 462, pl. 5, July 1926.

Holotype.— Fragment from posterior part of lower mandible, M. C. Z. 16,965 (misprinted M. C. Z. 1,695 in original description). South Carolina, phosphate deposits of Ashley River, horizon probably Miocene. Robert Wilson Collection.

Incertae sedis

† Archaeodelphis patrius G. M. Allen

Bull. Mus. Comp. Zoöl., **65**, p. 4, pl., 1921.

Holotype.— Imperfect skull, M. C. Z. 15,749. Locality unknown, but probably the Eocene of southern United States, perhaps South Carolina.

Iniidae

† Delphinus occiduus Leidy

Proc. Acad. Nat. Sci. Philadelphia, p. 197, 1868.

Holotype.— Piece of dental portion of rostrum, M. C. Z. 8,765. California, Half Moon Bay (Upper Miocene). J. D. Whitney.

= † *Lonchodelphis occiduus* (Leidy). See G. M. Allen, Journ. Mammalogy, **5**, p. 194, 1924.

Ziphiidae

† Anoplonassa forcipata Cope

Proc. Amer. Phil. Soc., **11**, p. 189, pl. 5, figs. 5, 5a, 1869.

Holotype.— Tip of lower jaw, M. C. Z. 8,766. Georgia, near Savannah, phosphate beds (Tertiary).

Delphinidae

† Delphinus calvertensis Harlan

Bull. of Proc. Nat. Inst. Promotion Sci., no. 2, p. 195, 3 pls., 1842.

Holotype.— Skull lacking lower jaw, M. C. Z. 3,795. Maryland, right bank of Chesapeake Bay, Calvert Cliffs (Miocene). About 1842. Francis Markoe, Jr.

= † *Lophocetus calvertensis* (Harlan).

† Pomatodelphis inaequalis G. M. Allen

Journ. Mammalogy, **2**, p. 148, pl. 11, fig. 10, 19 August 1921.

Holotype.— Fragment of the maxilla, M. C. Z. 15,750. Florida, Brewster, Polk County, "land-pebble phosphates," probably Miocene.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

Vol. LXXI. No. 5

ADDITIONAL NOTES ON THE BIRDS OF THE ALMIRANTE BAY REGION OF PANAMA

By James L. Peters

CAMBRIDGE, MASS., U. S. A.:

PRINTED FOR THE MUSEUM

February, 1931

No. 5.— *Additional Notes on the Birds of the Almirante Bay Region of Panama*

By James L. Peters

In the winter of 1926 Mr. Frederic H. Kennard visited Almirante on a collecting trip of some six weeks' (middle of February to end of March) duration, obtaining 127 species of birds. The collection was reported upon by Kennard and Peters (Proc. Boston Soc. Nat. Hist., **38**, no. 10, 26 January 1928, p. 443–465). In the summer of 1927 R. R. Benson also visited this region on behalf of the American Museum of Natural History, and his collection was reported upon very briefly by Griscom (Amer. Mus. Novit., no. 293, 12 January 1928, pp. 1–4).

Before leaving Almirante, Mr. Kennard trained H. Wedel in the art of preparing bird skins — good ones — and from June, 1926 until the beginning of 1929, when Mr. Wedel left for other fields, he had sent in over 1,000 skins, representing 272 species.

The bulk of these birds were generously presented to the Museum of Comparative Zoölogy by Mr. Kennard, and form one of the very best collections ever made in a given region in the American tropics. It is particularly interesting since it is the result of practically two and one-half years' steady work at all seasons, and shows the changes in plumage due to wear and moult not usually found in neotropical collections; it also furnishes some interesting data on the arrival and departure of North American migrants.

Wedel collected chiefly in the region about Almirante at the localities visited by Mr. Kennard at Chiriquicito and, like Mr. Kennard, also made a trip into the mountains reached by the Boquete trail. Several visits were made to the islands enclosing Almirante Bay. Another locality was Cricamola, a peninsula extending into the eastern part of the Chiriqui Lagoon. Wedel's collections emphasize what was already known, that the birds of the Almirante Bay and northern Chiriqui Lagoon regions are the same as those of the Talamanca Valley in south-eastern Costa Rica, but his results at Cricamola show what was not known previously, that this point marks the westward extension of many of the forms not known definitely hitherto beyond the Canal Zone, or in some cases the Rio Calovevora.

Griscom's paper *antea* lists the forms collected by Benson and recorded for the first time from Panama; practically all these birds with a few additions and some omissions were also recorded by Kennard and Peters in their paper fourteen days later.

Kennard and Peters made brief mention of the localities at which Kennard collected but, since Wedel worked at other places besides these, it may be well to append a short glossary, together with a few lines of general description of the region. For much of this information I am indebted to Mr. H. S. Blair, for many years division manager for the United Fruit Company at Almirante.

Most of the suitable land in the Caribbean lowlands in the vicinity of Almirante Bay and the Chiriqui Lagoon had been largely cleared, and planted to bananas by 1900, and for a good many years remained in a state of cultivation. The advent of the so-called "Panama disease" among the bananas, however, brought about a gradual abandonment of the banana lands. This abandonment is now virtually complete in the lands bordering on the Chiriqui Lagoon, though the fruit company properties in the Almirante section and westward toward the Sixaola have been planted to cacao.

A few miles back from the lowlands the hills rise sharply, attaining an elevation of about 7,500 feet on the continental divide, twenty miles from the Caribbean coast. The mountains are covered with the original heavy rain forest and are still absolutely untouched and unspoiled.

The rainfall of about 140 inches annually is well distributed throughout the year. There is no real dry season, but a period of "least rainfall" exists from January to March inclusive.

Almirante. The United Fruit Company headquarters situated on the western shore of Almirante Bay.

Banana River. A small stream of local origin emptying into Almirante Bay three or four miles north of Almirante.

Bocas del Toro. A Panamanian town of a population of about 3,000, capital of the province of Bocas del Toro, situated on the southeastern extremity of the Isla Colon, one of the islands enclosing Almirante Bay.

Boquete Trail. The overland trail from the Chiriqui Lagoon to Boquete on the Pacific slope. It begins at Chiriqui Grande, crosses the Guaruma River a few times and winds up the mountains, crossing at an elevation of about 6,000 feet some twelve or fifteen miles east of Boquete.

Buena Vista. A slight, cleared eminence at an elevation of about 1,200 feet at the northern end of the Boquete trail. A usual camp site for persons using the trail.

Changuinola. A station on the fruit company railway where it crosses the Changuinola River about twelve miles west of Almirante.

Changuinola Canal. A canal about six miles long paralleling the coast

a very short distance inland and extending from the mouth of the Changuinola River to Almirante Bay. It was originally dug to provide a safe waterway to transport bananas from the farms in the lower Changuinola Valley, but is no longer in use, though kept open by a fairly strong current. It passes through swamps for the greater part of its length. A large number of the water birds collected by Wedel were taken along this canal.

Chiriquicito. The almost forgotten terminus of a railway that ran three miles inland from Chiriqui Grande to the Guaruma River.

Chiriqui Grande. A fishing village (formerly a small banana shipping point) on the southern shore of the Chiriqui Lagoon.

Cedar Creek. A small tidal estuary at Almirante. It appears on few maps and then under the name of Quebrada Cedra. A few birds labeled Cider(*sic*) Creek by Wedel were doubtless taken on its banks.

Cricamola. A collection of huts at the mouth of the Rio Cricamola, southeastern end of the Chiriqui Lagoon. Wedel visited this place several times with interesting results.

Fruitdale. A settlement practically adjoining Almirante and synonymous with it. Wedel labeled many birds as coming from Fruitdale, but these have been listed as though taken at Almirante.

Guabo. Apparently has no existence as a place; Mr. Blair has never heard of it. The birds Wedel labeled Guabo appear to have been taken on the banks of the Rio Guabo, an affluent of the Rio Guaruma near Chiriquicito.

Isla Grande. An island in the Sixaola River near Victoria, about twenty miles northwest of Almirante.

Manati River. A short stream flowing through the swamps bordering the southern shore of the Chiriqui Lagoon between Chiriqui Grande and Cricamola.

Quebrada Nigua. A creek flowing into the bay about a mile and a half west of Almirante.

Western River. (Sometimes appearing on maps as Rio Occidente.) A small river emptying into the west side of Almirante Bay.

Shepherd Island. An island about a mile and a half long in the southwestern corner of Almirante Bay. Wedel took a few birds there.

Swan Key. One of the numerous islets enclosing the eastern side of Almirante Bay. It is not distinguished on maps available, but is said to lie between Isla Bastimentos and Isla Popa. It is noted chiefly as having the only known breeding colony of red-billed tropic birds in Panamanian waters.

The following annotated list includes all the species collected in the

Chiriqui Lagoon region by Kennard and Smith as well as Wedel. Mr. Ludlow Griscom has very generously turned over to me the manuscript catalogues of the collections made by R. R. Benson at Bocas del Toro and Almirante and the species taken by him not secured by the other collectors have also been included. Species taken by Wedel, as well as Kennard and Smith, are listed as additional specimens, but this notation is omitted when the latter collectors did not secure the bird. To avoid repetition but for the sake of completeness only, a nominal list of species collected by Kennard and Smith, but not sent in by Wedel, is appended at the end of the annotated list.

TINAMIDAE

Tinamus major fuscipennis Salvadori

Additional specimens. — Boquete trail: 1 ♀ (1,900 feet), 22 March 1928. Cricamola: 1 ♀, 21 August 1928.

Crypturellus soui modestus (Cabanis)

Zegla (near Almirante): 1 ♂, 16 December 1927. Guabo: 1 ♀, 11 April 1928.

These birds are both very dark above, the color of the upper parts nearest to *C. S. nigriceps* Chapman of eastern Ecuador. An example in the American Museum of Natural History collected at Almirante by Benson, 27 May 1927, is also dark. A comparison with topotypical *modestus* Cabanis (Journ. für Orn., 1869, p. 212, type from eastern Costa Rica, collected by Von Frantzius) being desirable, I borrowed four such examples from the Carnegie Museum (Carillo 1 ♂; Guapiles 1 ♂; Tucurrique 1 ♀; Cuabre, Talamanca 1 ♂). In the Museum of Comparative Zoölogy there are 8 ♂ and 6 ♀ from the Terrabá Valley and 4 ♂ and 1 ♀ from Chiriqui. A critical study of this series shows that the range of individual variation is so great that the birds from Costa Rica and western Panama are best regarded, for the present at least, as belonging to one and the same race.

Crypturellus soui is a species not only susceptible to environmental conditions, but some of the races have two color phases not definitely correlated with age or sex. In the "red phase" the underparts are uniform reddish brown (in some subspecies washed with gray on chest and flanks) and the upper parts, especially the wing coverts, washed with rusty or cinnamomeous. The "brown phase" birds are brownish gray or grayish-brown with a rusty tinge in some individuals. Of the

Central American races, *meserythrus* is almost always in the red phase; *panamensis* is about evenly divided between brown and red, while in *modestus* the full development of the red phase seems to be aborted, but traces are discernible in some individuals in the form of a cinnamomeous wash.

CRACIDAE

Crax globicera globicera (Linné)

Almirante: 1 ♀, 16 February 1929.

Penelope cristata cristata (Linné)

Additional specimen.— Guabo: 1 ♀, 14 April 1928.

Ortalis cinereiceps cinereiceps (Gray)

Additional specimens.— Guabo: 5 ♂, 2 ♀, 5–11 April 1928. Cricamola: 1 ♂, 18 September 1927; 2 ♀, 23 July; 1 ♀, 23 August; 1 ♀, 29 August 1928.

The series from the Chiriqui Lagoon, as well as specimens from the Talamanca Valley, are the same as essentially topotypical material from the Canal Zone.

In naming *O. c. saturatus* (Amer. Mus. Novit., no. 25, 1921, p. 1) Messrs. Miller and Griscom wholly overlooked *Ortalis frantzii* (Cabanis) (Journ. für Orn., 1869, p. 211, eastern Costa Rica). Although *saturatus* was described from Nicaragua, its sponsors included eastern Costa Rica in its range on the basis of actual specimens, thus it appears that the Chachalaca of the Caribbean lowlands of eastern Nicaragua and northeastern Costa Rica should be called *Ortalis cinereiceps frantzii* (Cabanis).

ODONTOPHORIDAE

Odontophorus melanotus coloratus Griscom

This well-marked form was originally described from Guaval (1,500 feet) on the Rio Calovevora. Wedel sent in 1 ♂ and 2 not sexed, Boquete trail (1,500–3,500 feet), 21–30 March 1928; 1, not sexed, Guabo, 10 April 1928; 1 ♂, Cricamola, 15 February 1928.

Except that these birds all have the dusky tips to the crest feathers, they agree with *coloratus;* a larger series is necessary to confirm the significance of the presence or absence of this marking.

Neither Kennard nor Benson found this forest quail.

COLUMBIDAE

Columba speciosa Gmelin

Additional specimens.— Almirante: 1 ♂, 20 November 1927. Western River: 1 ♂, 2 June 1928. Cricamola: 2 ♂, 1 ♀, 19 August 1928.

While there is a great deal of variation in this pigeon, it is all individual and not geographical. In some birds the lustre is greenish and in others purplish, the central portion of the breast and neck is sometimes white, sometimes rusty, sometimes both colors are present; females are duller than males.

Columba rufina pallidicrissa Chubb

Additional specimens.— Changuinola: 2 ♂, 27 January 1929. Almirante: 1 ♀, 21 August 1927; 2 ♂, 18 December 1928. Western River: 1 ♂, 2 June 1928. Shepherd Island: 1 ♂, 1 ♀, 17 May 1928. Gerchow Key: 1 not sexed, 5 July 1928.

Columba nigrirostris Sclater

Additional specimens.— Almirante (and vicinity): 1 ♂, 10 June 1927; 4 ♂, 16 May to 17 July 1928. Guabo: 1 ♂, 5 April 1928. Cricamola: 1 ♂, 13 February 1928; 2 ♂, 11–25 August 1928.

Benson also secured this species at Almirante.

Columbigallina rufipennis rufipennis (Bonaparte)

Almirante and vicinity: 1 ♂, 3 May; 1 ♂, 16 December 1927. Changuinola: 1 ♂, 1 ♀, 2 December 1927; 1 ♂, 21 October 1928. Isla Grande: 1 ♀, 23 June 1928.

Also collected by Benson at Almirante.

Claravis pretiosa pretiosa (Ferrari-Perez)

Additional specimens.— Changuinola: 1 ♂, 29 April. Almirante: 1 ♂, 9 November 1928.

Leptotila plumbeiceps notius subsp. nov.

Type.— No. 137,625 Museum of Comparative Zoölogy, adult male from Almirante, Panama. Collected 15 November 1928 by H. Wedel (orig. no. 1,034).

Characters.— Similar to *L. p. plumbeiceps* (Sclater and Salvin) but deeper olive brown above; gray of head darker and bluer; upper parts

more extensively iridescent. Below deeper and clearer vinaceous; malar and suborbital region buffy instead of brownish gray.

In addition to the type Wedel sent in another specimen, a male, taken at Changuinola, 30 September 1928. Benson collected a ♀ at Bocas del Toro, 23 September 1927.

L. p. malae Griscom appears to be nearer to *L. p. battyi* (Rothschild) of Coiba Island, but is more olive and less reddish brown above. Like *battyi, malae* is decidedly washed below with vinaceous plumbeous.

Material examined

L. p. plumbeiceps. Mexico: southern Vera Cruz 1 ♂. Honduras: Ceiba 1 ♂, 2 ♀; Tela 1 ♀. Costa Rica: Bolson 2 ♂.
L. p. malae. Panama: Cape Mala 1 ♀ (the type).[1]
L. p. battyi. Coiba Island: 1 ♂,[1] 2 ♀.[1]
L. p. notius. 2 ♂, 1 ♀.[1]

LEPTOTILA CASSINI CASSINI (Lawrence)

Almirante and vicinity: 1 ♂, 2 November 1927; 1 ♂, 10 November 1928. Changuinola: 1 ♂, 1 ♀, 1 not sexed, 4 October to 9 December 1928. Guabo: 2 ♂, 3 ♀, 10–25 April 1928. Cricamola: 1 ♂, 14 August 1928.

OREOPELIA MONTANA (Linné)

Changuinola: 1 ♀, 31 December 1928. Boquete trail: 1 ♂, 1 April. Guabo: 1 ♂, 5 April 1928.

Also sent in by Benson from Almirante.

OREOPELIA VERAGUENSIS (Lawrence)

Cricamola: 1 ♂, 21 August 1928.

OREOPELIA LAWRENCII LAWRENCII Salvin

Boquete trail: 3 ♂, 2 ♀, 17–30 March 1928 (elevations from 1,500 to 3,500 feet).

This species was originally described from specimens collected at Calobre, Veraguas, by Arcé. It has since been one of the very rarest of quail doves, known besides the type locality only from a few scattered stations in Costa Rica.

In addition to the five specimens listed here, there are in the Museum

[1] Specimens in the American Museum examined.

of Comparative Zoölogy an adult ♂ and an immature ♂ from Tenorio, and an adult ♀ from Carriblanco de Sarapiqui, all in northwestern Costa Rica. I have also been privileged to examine an immature ♂ from the Dwight collection, taken 16 February 1925 by Austin Paul Smith at Guacimo, eastern Costa Rica. To the best of my knowledge, besides these nine specimens, the only other example in this country is a ♂ in the Carnegie Museum, collected by M. A. Carriker, Jr., 20 August 1905, at Carillo, eastern Costa Rica; this bird I have not seen.

The three birds from northwestern Costa Rica represent a very different form from the one inhabiting the mountains above the Chiriqui Lagoon and in eastern Costa Rica. In the absence of strictly topotypical material of *lawrencii* I have made comparison of the two series with the description of the bird in the Catalogue of Birds of the British Museum founded entirely on Veraguas types, and with the excellent plate in the Biologia Centrali-Americana (plate 69). The birds previously enumerated as from the Caribbean slope are certainly typical *lawrencii*, and the bird of northwestern Costa Rica I name

OREOPELIA LAWRENCII LENTIPES subsp. nov.

Type.— Adult ♂, no. 121,126 Museum of Comparative Zoölogy, from Tenorio, Costa Rica, collected 11 February 1908 by C. F. Underwood.

Characters.— Similar to *O. l. lawrencii* but much paler; upper interscapular region "light brownish olive" rather than much browner, less greenish olive. Below noticeably paler; breast lighter and purer gray, and washed with greenish only on the sides; flanks and undertail coverts paler. Size slightly larger.

O. l. lawrencii ♂, wing 137–142 (138); ♀ wing, 139–141 (140).

O. l. lentipes ♂, wing 144–146 (145); ♀ wing 143.

RALLIDAE

ARAMIDES AXILLARIS Lawrence

Quebrada Nigua: 1 ad. ♀, 1 imm. ♀, 14, 15 January 1929.

In addition to these two specimens, I have examined one from the Santa Marta region and two from Costa Rica in the Museum of Comparative Zoölogy, as well as the type of the species from Colombia, a pair of adults from Nicaragua, and an adult and two immature from western Ecuador in the American Museum of Natural History. There

does not appear to be any geographic variation throughout this extensive range.

The species has been recorded from as far north as near San Blas, Nayarit, Mexico (McClellan, Proc. Cal. Acad. Sci. (4), **16**, no. 1, 1927, p. 11.

Aramides cajanea cajanea (P. L. S. Müller)

Additional specimens.— 18 both sexes, adults and immature, from practically every collecting locality in the region.

Amaurolimnas concolor guatemalensis (Lawrence)

Almirante: an ad. ♀, 5 August 1927. The measurements are: wing 110, culmen 25.5.

Porzana carolina (Linné)

Almirante and Changuinola: 4 ♀, 25 October and 4 November 1926; 29 October 1927; 17 October 1928.

Creciscus cinereiceps (Lawrence)

Additional specimens.— Almirante and vicinity: 1 ♀, 25 December 1928; 1 ♂, 2 January 1929. Changuinola: 1 ♂, 15 October 1927; 1 ♂, 21 January 1929. Guabo: 1 ♂, 1 ♀, 15 April 1928.

Benson sent in eight adults and two juveniles. Griscom (Amer. Mus. Novit., no. 280, 1927, p. 2 [in text]) records *C. cinereiceps* from the Rio Calovevora; this appears to be its eastern limit in Panama.

Gallinula chloropus cachinnans Bangs

Additional specimens.— Changuinola: 1 ♀, 28 October 1926; 1 imm., 17 November 1927; 1 ♀, 2 December 1927; 2 ♂, 14 July 1928.

Benson sent in one adult.

Kennard and Peters previously referred a specimen taken in February to this race. The two males collected on 14 July are obviously resident birds, both fully adult, and with swollen frontal shield. I cannot distinguish them from North American examples of the same sex and season, and without the slightest hesitation sink *Gallinula chloropus centralis* Miller and Griscom as a synonym.

Ionornis martinica (Linné)

Additional specimens.— Changuinola: 1 ♂, 28 October; 1 ♀, 24 November 1926; 1 ♂, 28 November 1927; 1 ♀, 5 November 1928. Banana River: 1 ♂,

15 November 1926. Sixaola, Elena: 1 ♀, 15 January 1927. Cricamola: 1, not sexed, 12 February 1928.

Fulica americana americana Gmelin

Almirante: 1 imm. ♀, 14 November 1926. Changuinola: 2 ♂, 1 ♀, 17–25 November 1927.

These birds are not different from North American examples.

HELIORNITHIDAE

Heliornis fulica Boddaert

The fin-foot appears to be a locally common resident. Wedel sent in 1 ♂, 7 ♀, all taken on the Changuinola River and Changuinola Canal between 13 October 1927 and 14 July 1928.

Of the sixteen specimens of this species in the Museum of Comparative Zoölogy, only four are males. It would be of interest to ascertain whether this disparity in sex ratio is constant.

COLYMBIDAE

Poliocephalus dominicus brachypterus (Chapman)

Additional specimens.— Changuinola River and Canal: 1 ♂, 6 ♀, 1 not sexed, 22 November 1926 to 14 July 1928.

Podilymbus podiceps podiceps (Linné)

Almirante: 1 ♀, 22 December 1927.

This specimen, obviously a bird of the year, can be matched exactly by winter examples from Florida.

LARIDAE

Chlidonias nigra surinamensis (Gmelin)

Cricamola: 1 ♀, 19 September 1927.

CHARADRIIDAE

Squatarola squatarola (Linné)

Changuinola: 2 ♀, 28 October 1926; 8 November 1927.

Charadrius vociferus vociferus Linné

Columbus Island: 1 ♂, 30 January 1927. Almirante: 1 ♂, 1 not sexed, 24 November 1927. Changuinola: 1 ♀, 26 November 1927. Banana River: 1 ♀, 8 December 1927.

SCOLOPACIDAE

Catoptrophorus semipalmatus inornatus (Brewster)

Cricamola: 1 ♀, 19 September 1927.

This specimen is a typical example of the western race of the willet. Griscom (Amer. Mus. Novit., no. 282, 1927, p. 3) records this subspecies from the Pacific coast of Panama, but it has never been taken before on the Caribbean slope.

Totanus flavipes (Gmelin)

Changuinola: 1 ♀, 2 December 1927.

Actitis macularia (Linné)

Fruitdale: 1 ♂, 1 ♀, 29 August; 1 not sexed, 31 August 1927.

The bird shot on 31 August is an adult that has not yet begun to moult. The last of August is not an unusual date of arrival of Spotted Sandpipers from the north even as far south as Panama. Noble collected it in northwestern Peru, 27 August 1916, and Benson took it in Darien 25 July 1928.

Capella gallinago delicata (Ord)

Banana River: 1 ♀, 6 December 1927. Almirante: 1 ♂, 16 November 1928.

PARRIDAE

Jacana spinosa spinosa (Linné)

Additional specimens.— Changuinola River: 1 ♀, 27 May; 1 ♂, 26 November; 1 not sexed, 2 December 1927.

EURYPYGIDAE

Eurypyga major major Hartlaub

Additional specimens.— Cricamola: 1 ♂, 11 September 1927; 1 ♀, 11 February 1928. Guabo, 1 ♀, 14 April 1928.

THRESKIORNITHIDAE

Mesembrinibis cayennensis (Gmelin)

Changuinola Canal: 1 ♂, 8 November; 1 ♂, 9 December; 1 ♀, 10 December. Chiriquicito: 1 ♀, 18 April 1928.

As far as I am aware this bird has never been previously recorded west of the Canal Zone.

CICONIIDAE

Mycteria americana Linné

Almirante: 1 ♂, 25 April 1928.

Jabiru mycteria (Lichtenstein)

Cricamola: 1 ♂, 11 August 1927.

ARDEIDAE

Ardea herodias herodias Linné

Changuinola River: 1 imm. ♀, 31 October 1927.

Oberholser (Proc. U. S. Nat. Mus., **43**, 1912, p. 555) resurrects Wagler's *Ardea lessonii* and applies it to the breeding birds of Mexico, Central America and northern South America. I am not prepared at this time to go into the question of a breeding race of the Great Blue Heron in central Mexico, but there is no evidence at all to show that the bird breeds anywhere in Central America, nor in northern South America. I regard Great Blue Herons from Central America as North American migrants, and consider the occasional summer records as relating to stragglers and not to any resident form.

The average measurements given by Dr. Oberholser for the females of *A. h. herodias*, *A. h. lessoni*, compared with the specimen from Changuinola are tabulated herewith:

	herodias	*lessonii*	M. C. Z. 137,088
Wing	451.2	455.7	461
Tail	173.7	177	187
Bill	137	125.7	129
Tarsus	175	188.5	170
Middle toe	102	100	103

Immature *herodias* can be distinguished from *A. cocoi* of the corresponding plumage by rusty instead of white tibiae, more rusty on the bend of the wing and underwing coverts, and generally darker, more brownish gray, coloration above.

Florida caerulea (Linné)

Additional specimen.— Almirante: 1 ♂, 30 April 1927.

Hydranassa tricolor ruficollis (Gosse)

Almirante: 1 ♀, 17 December 1926.

Nyctanassa violacea violacea (Linné)

Almirante: 2 ♀, 19 December 1926. Bocas del Toro: 1, not sexed, 6 November 1927. Changuinola: 1 ♀, 21 January 1929.

Cochlearius cochlearia panamensis Griscom

Fruitdale: 1 ♂, 14 November 1928. Changuinola: 1 ♂, 1 ♀, 29 November 1928.

Butorides virescens maculatus (Boddaert)

The series of green herons from Almirante Bay, including those brought back by Kennard and Smith (previously identified as *B. v. virescens*) consists of 16 specimens; 10 adults and 6 immature. The most striking thing about this series is the large proportion of erythristic or melanistic individuals, no less than five adults and two immature being thus marked. The coloration in these cases is much as in normal examples, except that the maroon portion of the neck is slaty-black with a gray wash; the throat and foreneck instead of being white with blackish marks are uniform deep purplish chestnut; the abdomen is dark slate gray instead of pale gray.

I believe that the large percentage of abnormally colored individuals is easily accounted for. It is well known that *Butorides virescens* has a latent tendency toward the production of erythristic or melanistic individuals, and this tendency may crop out frequently in some regions and not at all in others. This is particularly true of the island of Cuba, where a variant of *B. v. maculatus* is found in which the throat and foreneck are completely maroon or purplish chestnut like the sides and back of the neck.

Before going further into the subspecific identity of the Almirante birds it is necessary to review briefly the characters by which the east-

ern North American, West Indian and Central American green herons may be distinguished. After comparing a splendid series of topotypical *virescens* with an almost equally good series of *maculatus* from various islands in the West Indies, I am convinced that the two races may be separated only on the basis of comparative size and that any color characters are purely seasonal.

B. v. virescens	10 ♂, wing 177–186 (181.2)
	10 ♀, wing 172–186 (178.3)
B. v. maculatus	(various islands in the West Indies)
	10 ♂, wing 159–171 (166.6)
	10 ♀, wing 156–173 (164.6)

The measurements of the West Indian birds are based on summer specimens, obviating the possibility of including migrants.

Of the sixteen Almirante birds, four were taken in the winter and four more in spring or fall, so there are at least eight possible migrants. Tabulating the measurements of undoubted summer residents gives:

Adult	♂, 10 June	Wing 168	normal coloration
Immature	♂, 21 July	165	
Immature	♂, 21 July	159	
Immature	♂, 21 July	165	
Adult	♂, 26 July	171	abnormal coloration
Adult	♀, 21 August	170	
Immature	♂, 18 August	166	
Immature	♂, 20 August	157	

These measurements approximate seasonably comparable West Indian examples almost exactly.

The winter, spring and fall individuals measure as follows:

Adult	♂, 21 December	Wing 165	normal coloration
Adult	♂, 14 February	173	
Adult	♂, 14 February	173	
Adult	♂, 30 September	173	
Immature	♂, 6 May	172	
Adult	♂, 14 February	177	abnormal coloration
Adult	♂, 3 May	175	
Adult	♀, 1 October	167	

It will be noted that most of these obviously belong to the smaller resident form, others are on the border line and might be referred to either *virescens* or *maculatus*.

I am unable to recognize the bird described by Oberholser under the name of *B. v. hypernotius,* and attributed by him to eastern Central America. The color characters break down, and the measurements are not sufficiently or constantly above those of *maculatus* to separate two forms.

Tigrisoma lineatum lineatum (Boddaert)

Changuinola: 1 ad. ♀, 13 September 1928; 1 ♂, 1 ♀, 20 February 1929; 1 imm. ♂, 1 imm. ♀, 20 February 1929. Quebrada Nigua: 1 imm. ♀, 14 January 1929. Cricamola: 1 ad. ♂, 13 August 1928.

I can detect no difference between these examples and a series of ten from Surinam, that may be considered topotypical.

ANATIDAE

Querquedula discors (Linné)

Changuinola: 1 ♂, 2 November; 1 not sexed, 25 November 1927; 1 ♂, 23 September 1928.

Nyroca affinis (Eyton)

Cider Creek: 1 ♀, 15 November 1927. Changuinola: 2, not sexed, 2 December 1927.

PHALACROCORACIDAE

Phalacrocorax olivaceus olivaceus (Humboldt)

Manati River: 1 ♀, 11 November 1927. Western River: 1 ♀, 27 June 1928.

ANHINGIDAE

Anhinga anhinga (Linné)

Changuinola: 1 ♂, 19 June 1928.

SULIDAE

Sula leucogaster leucogaster (Boddaert)

Additional specimens.— Swan Key: 1 ♂, 3 June 1927.

PHAËTHONTIDAE

Phaëthon aethereus mesonauta Peters

Swan Key: 4 ♂, 4 ♀, 3 June 1927.

The presence of a breeding colony of red-billed tropic birds in Almirante Bay was first recorded by Griscom (Amer. Mus. Novit., no. 293, 1928, p. 1) on the basis of nine specimens collected there by Benson. These birds constituted the first record for the species in Panama.

CATHARTIDAE

Sarcorhamphus papa (Linné)

A King Vulture was received in the flesh from H. S. Blair, taken near Almirante, 6 January 1925. Benson also took a specimen.

FALCONIDAE

Daptrius americanus americanus (Boddaert)

Almirante: 5 ♂, 1 ♀, 24 May 1926, 25 March 1927; 1 ♀, 17 February 1929.

Specimens from Almirante appear to be intermediate between this form and *guatemalensis* Swann; since the sexing of the series, however, does not appear to be accurate, I leave the matter of exact subspecific determination in abeyance.

In a paper to be published shortly, I shall show that Daptrius Vieillot must replace Ibycter Vieillot.

Herpetotheres cachinnans cachinnans (Linné)

Additional specimens.— Cricamola: 1 ♂, 6 August 1928. Almirante: 1 ♀, 12 October 1928.

I believe that the laughing falcons, on the Caribbean slope of Central America north at least to Costa Rica, are best referred to the typical form, though some are obviously intermediate between it and *fulvescens*.

Micrastur semitorquatus naso (Lesson)

Changuinola: 1 ♂, 10 October 1928. Cricamola: 1 ♀, 24 August 1928.

Carnifex naso Lesson, Echo du Monde Savant (6), **2**, 1842, col. 1,085 Realejo, Nicaragua) is an earlier name for *Falco percontator* Cabot,

Journ. Boston Soc. Nat. Hist., 4 January 1844, p. 462 (Chichen-Itza Yucatan).

Falco sparverius sparverius Linné

Additional specimens.— Quebrada Nigua: 1 ♂, 1 ♀, 1 November 1927. Almirante: 1 ♀, 24 November 1927. Banana River: 1 ♀, 8 December 1927.

Falco albigularis albigularis Daudin

Changuinola Canal: 1 ♂, 9 December 1927.

Falco peregrinus anatum Bonaparte

Changuinola: 1 ad. ♀, 3 May 1928.

The specimen is in worn and faded plumage and moulting irregularly, having a partly grown left outer primary, the old right outer shed, but not yet replaced; two fresh rectrices on the right side of the tail, and a few scattered, fresh contour feathers.

ACCIPITRIDAE

Harpagus bidentatus fasciatus Lawrence

Almirante: 1 (♂), 5 March 1927; 1 ♀, 13 September 1928. Changuinola: 1 imm. ♂, 14 November 1927.

To my mind this is a very poorly marked race, and one that probably should be synonymized with *bidentatus.*

Spizastur melanoleucus (Vieillot)

Banana River: 1 ♀, 10 December 1927.

Spizaëtus tyrannus (Wied)

Changuinola: 1 ♀, 29 September 1927. Fruitdale: 1 [♀], 18 November 1928.

Harpia harpyja (Linné)

Near Almirante: 1 ?, 15 April 1923; 1 ad. ♂, 26 March 1924. (Both these birds were shot by Mr. H. S. Blair, Division Manager of the United Fruit Company at Almirante, and were frozen and sent to the museum in the flesh.) Banana River: 1 ♂, 21 April 1928 (H. Wedel).

Morphnus guianensis Daudin

Banana River: 1 ♀, 30 January 1928. Changuinola: 1 ♂, 30 November 1928.

Circus cyaneus hudsonius (Linné)

Fruitdale: 1 ♀, 22 November 1928.

Parabuteo unicinctus harrisii (Audubon)

Almirante: 1 ♀, 24 November 1927.

Urubitinga urubitinga ridgwayi Gurney [1]

Almirante: 2 ♂, 16, 23 April 1927.

Urubitinga anthracina anthracina (Lichtenstein)

Additional specimens.— Almirante: 1 ♂, 3 June 1926; 1 ?, 14 September 1928. Western River: 1 ♀, 24 July; 1 ♂, 30 September; 1 ♂, 24 November 1927. Banana River: 1 ♂, 7 December 1927. Changuinola: 1 ♂, 15 October 1927; 1 ?, 25 February 1928; 1 ?, 19 February 1929.

Leucopternis ghiesbreghti costaricensis W. L. Sclater

Additional specimens.— Almirante: 1 ♀, 2 September 1926; 1 ♂, 27 February 1927; 2 ♂, 16, 23 April 1927. Boquete trail (2,000 feet): 1 ♂, 24 March 1928.

The genus Leucopternis as understood today is to my mind a very heterogeneous conglomeration of species. Ridgway began its dismemberment by creating Morphnarchus (Smithsonian Misc. Coll., **72**, no. 4, 1920, p. 2) as a monotypic genus for *L. princeps*. Apparently he did not see some of the other commonly included species or he would doubtless have created additional genera. I am not certain whether Leucopternis should be dismembered, or whether some of its species should be transferred to existing genera. One or the other of these courses is certainly indicated, but the choice of action and its execution I leave to others.

Leucopternis semiplumbea Lawrence

Almirante: 1 ♀, 21 June 1928. Changuinola: 1 ?, 21 January 1929.

Buteo jamaicensis costaricensis Ridgway

Changuinola: 1, sex not determined, 9 December 1928.

This bird is in somewhat worn immature plumage, but noticeably darker than most immature red-tailed hawks from North America; it more nearly resembles *B. j. alascensis;* the wing measures 365 mm.

[1] I am entirely aware that Morphnus must replace Urubitinga by opinion of the International Commission on Zoölogical Nomenclature, but this leaves *Morphnus guianensis* without a generic name, and owing to the uncertainty regarding the dates of publication of the supplement of the Dict. Sci. Nat., I prefer to leave matters in *statu quo* pending a more satisfactory solution of the question.

Buteo platypterus platypterus (Vieillot)

Additional specimens.— Changuinola: 1 ♂, 17 November 1928; 1 ♂, 21 January 1929. Banana River: 21 December 1927. Cricamola: 1 ♂, 11 February 1928.

Buteola brachyura (Vieillot)

Changuinola: 1 ♀, 5 November 1928.

Rupornis magnirostris arguta Peters and Griscom

Additional specimens.— Almirante: 1 ♂, 27 May 1927; 1 ♀, 6 February 1928. Western River: 1 ♂, 24 July 1927. Changuinola: 1 ♂, 17 October 1927. Shepherd Island: 1 ♂, 17 May 1928. Cricamola: 1 ♂, 15 August 1928.

Accipiter bicolor bicolor (Vieillot)

Fruitdale: 1 ? (♀ by measurement), 17 February 1929.

This must be a rare bird in the Almirante Bay region, as the single specimen taken by Wedel is the only one collected in the region in three years of field work, neither Kennard nor Benson having found it. The specimen is fully adult. Compared with the type of *A. b. fidens* Bangs and Noble, it substantiates the characters of the latter race, *i.e.*, larger size and darker coloration. *Fidens*, however, appears to be restricted to the northern portion of the range of the species in Vera Cruz. Adult males from Quintana Roo and Honduras (Yaruca) agree in coloration with an adult male from southwestern Costa Rica, though slightly larger. Until additional comparable material is at hand, however, it is best to regard them as intermediates.

STRIGIDAE

Pulsatrix perspicillata saturata Ridgway

Almirante: 1 ♂, 24 October 1926; 1 ♂, 15 January 1927. Changuinola: 1 ♂, 28 November 1927.

Ciccaba virgata centralis Griscom

Neither Kennard's party nor Wedel ever met with this rather common owl. Benson sent one to the American Museum from Almirante in the summer of 1927.

TYTONIDAE

Tyto perlata guatemalae (Ridgway)

Additional specimen.— Almirante: 1 ?, 29 March 1927.

PSITTACIDAE

Ara ambigua ambigua (Bechstein)

Almirante: 1 ♂, 20 September 1926; 1 ?, 31 March 1927; 1 ♀, 25 June 1927. Chiriquicito: 1 ♀, 18 April 1928.

Aratinga finschi (Salvin)

Additional specimens.— Banana River: 1 ♂, 19 June 1926. Fruitdale: 1 ♀, 10 June 1928.

Aratinga astec astec (Souancé)

Changuinola: 1 ♀, 3 October 1927.

This paroquet was first recorded from the Almirante region by Griscom (Am. Mus. Novit., no. 293, 1928, p. 2) and described as a new subspecies under the name of *Eupsittula astec extima.* I have examined the type and other specimen, both collected at Bocas del Toro, 24 August 1927, and admit that these birds, compared with the material of typical *astec* and *a. vicinalis* available to Griscom in the American Museum at that time, certainly afforded good grounds for his supposed separation. The material at my command in the Museum of Comparative Zoölogy, however, does not support the claims of *extima* to recognition. The specimen sent in by Wedel is indistinguishable from examples of *a. astec* from Vera Cruz, Guatemala and British Honduras, and is quite unlike any specimen in our series of ten *vicinalis* (including the type).

Pyrrhura hoffmanni gaudens Bangs

Additional specimens.— Boquete trail, 1,800 feet: 2 ♀, 25 March 1928. Cricamola: 1 ♀, 15 February 1928.

Amazona farinosa virenticeps (Salvadori)

Almirante: 1 ♂, 1 ♀, 16 April 1927.

Pionus menstruus (Linné)

Additional specimens.— Almirante: 1 ♀, 4 July 1927; 1 ♂, 17 September 1928. Cricamola: 1 ♀, 13 February 1928.

Pionus senilis decoloratus Griscom

Not met with, except by Benson, who took three at Almirante in 1927 (recorded by Griscom, Amer. Mus. Novit., no. 293, 1928, p. 1, as *Pionus senilis* (Spix)).

EUCINETES HAEMATOTIS HAEMATOTIS (Sclater and Salvin)

Additional specimens.— Cricamola: 1 ♂, 1 ?, 13, 21 August 1928.

It is interesting to note that the two birds listed here are typical of *h. haematotis* in every respect and show no approach to *h. coccineicollaris* (Lawrence) of the Canal Zone and eastward.

From Divala, on the Pacific slope of northwestern Panama, the Museum of Comparative Zoölogy has a series of seven specimens of *Eucinetes haematotis*, five of which are perfectly typical *h. haematotis*, but two others show a decided resemblance to *h. coccineicollaris*, both having the middle of the throat white, and one of them with a strong indication of the rosy jugulum; both, however, have the extensively red auricular region characteristic of the typical form.

ALCEDINIDAE

MEGACERYLE TORQUATA TORQUATA (Linné)

Additional specimens.— Western River: 1 ♂, 1 ♀, 24 July; 7 October 1927. Fruitdale: 1 ♀, 4 August 1927. Cricamola: 1 ♀, 17 September 1927.

MEGACERYLE ALCYON ALCYON (Linné)

Changuinola: 1 ♂, 17 October 1927.

CHLOROCERYLE AMAZONA (Latham)

Additional specimens.— Isla Grande: 1 ♀, 18 July. Almirante: 1 ?, 29 August. Changuinola: 1 ♀, 16 August. Cricamola: 1 ♂, 18 August 1927.

CHLOROCERYLE AMERICANA ISTHMICA (Goldman)

Additional material.— Many specimens from nearly all collecting stations

CHLOROCERYLE INDA (Linné)

Additional specimens.— Almirante: 2 ♂, 30 April, 5 May 1927.

CHLOROCERYLE AENEA AENEA (Pallas)

Additional specimens.— Banana River: 1?, 17 June 1926. Almirante: 1 ♀, 16 April; 2 ♂, 4, 27 August 1927. Quebrada Nigua: 1 ♀, 20 July 1927; Changuinola: 2 ♂, 3, 13 October 1927. Chiriquicito: 1 ♂, 16 April 1928. Cricamola; 1 ♂, 1 ♀, 20, 21 September 1927.

MOMOTIDAE

Baryphthengus martii semirufus (Sclater)

Additional specimens.— Almirante: 1 ♀, 14 August 1926; 1 ♂, 16 April 1927; 1 ♂, 12 November 1928. Guabo: 3 ♂, 1 ?, 2–15 April 1928. Western River: 1 ♂, 12 July 1928. Changuinola: 1 ♀, 15 October 1928. Boquete trail, 1,300 feet: 1 ♂, 14 March 1928. Cricamola: 1 ♂, 13 February 1928.

Electron platyrhynchum minor (Hartert)

Additional specimens. — Boquete trail, 1,300–3,500 feet: 2 ♂, 1 ♀, 19–29 March 1928.

Carriker in his Birds of Costa Rica (p. 495) gives the range of this bird in eastern Costa Rica as "the whole of the Caribbean lowlands up to 2,000 feet."

CAPRIMULGIDAE

Nyctidromus albicollis intercedens Griscom

Changuinola: 1 ♀, 1 ?, 30 November, 31 December 1928.

Chordeiles acutipennis micromeris Oberholser

Fruitdale: 1 ♀, 2 January 1929.

APODIDAE

Streptoprocne zonaris albicincta (Cabanis)

Fruitdale: 1 ♂, 1 ♀, 17 November 1928.

Chaetura pelagica (Linné)

Changuinola River: 1 ♀, 24 October 1926.

TROCHILIDAE

Threnetes ruckeri ventosus Bangs and Penard

Changuinola: 1 ♂, 27 September 1927. Almirante: 1 ♀, 24 February; 1 ♂, 7 November; 1 ♂, 29 December 1928. Guabo: 1 ♂, 16 April 1928.

Phœthornis superciliosa cephala (Bourcier and Mulsant)

Changuinola: 1 ♂, 30 November 1928. Banana River: 1 ♀, 17 July 1928.

Phœthornis adolphi saturatus Ridgway

Changuinola: 1?, 30 September 1928. Cricamola: 1 ♂, 28 August 1928.

Simon in his "Histoire Naturelle des Trochilidae" places this and several closely allied species in the genus *Pygmornis*, at the same time breaking up the genus *Phœthornis* as usually constituted, into six genera. Such a course seems to me to be totally unwarranted. As far as my own field experience goes "Pygmornis" is practically a miniature counterpart of Phœthornis, fitting into a different niche but with identical notes and habits.

Florisuga mellivora mellivora (Linné)

Changuinola: 1 ♂, 24 October 1926; 1 ♀, 3 October 1927; 1 ♀, 29 September 1928. Almirante: 1 ♀, 22 September 1926; 1 ♂, 13 May; 1 ♂, 20 July 1927. Guabo: 1 ♀, 2 April 1928. Cricamola: 1 ♂, 16 August 1928.

Polyerata amabilis (Gould)

Isla Grande: 1 ♂, 18 July 1927. Guabo: 1 ♂, 12 April 1928.

Amizilis tzacatl tzacatl (De la Llave)

Almirante: 4 ♂, 2 ♀, 14 May 1927 to 23 May 1928.

All modern authors are now agreed that *Amizilis tzacatl* is not divisible into geographic races, except that in the southwest portion of its range in Colombia and Ecuador there is a resident form with paler posterior underparts (*jucunda* Heine). Throughout the rest of its range from Mexico southward, the bird shows a great deal of variation, due largely to age. Old birds are deeper green above and the upper mandible flesh colored at the base, while those less mature have the upper parts more gold or coppery, and sometimes the entire mandible is black. The length of the bill appears to be purely a matter of individual variation.

Chlorostilbon assimilis Lawrence

Cricamola: 1 ♂, 13 August 1927.

Thalurania colombica venusta (Gould)

Found only by Benson who secured two specimens at Almirante and three at Bocas del Toro.

Chalybura urochrysa isaurae (Gould)

Boquete trail, 1,400–1,500 feet: 2 ♂, 17–20 March 1928. Benson secured this bird at Almirante and Bocas del Toro.

Simon (Hist. Nat. Troch., 1921, pp. 129, 340) has split the genus *Chalybura*, making *Chalybura* monotypic for *buffonii* and its subspecies, and placing *melanorrhoa*, *intermedia* and *urochrysa* in his new genus *Chlorurisca*. The sole difference given to distinguish the two genera is the length of the under tail coverts; this single character is not sufficiently trenchant to form the basis for a generic separation, especially so since *urochrysa* is the "connecting species."

Heliothryx barroti (Bourcier)

Western River: 1 ?, 27 June 1928. Almirante: 1 ♂, 12 October 1928.

Heliomastes longirostris longirostris (Vieillot)

Met with only by Benson who took one at Bocas del Toro.

TROGONIDAE

Trogon curucui tenellus Cabanis

Boquete trail: 1 ♂, 1 ♀, 14–19 March 1928.

Trogon violaceus concinnus Lawrence

Quebrada Nigua: 1 ♂, 1 November 1927.

Trogon massena massena Gould

Additional specimens.— Quebrada Nigua: 1 ♂, 1 November 1927. Almirante: 1 ♀, 14 November 1928. Boquete trail, 1,300 feet: 1 ♂, 2 ♀, 17–19 March 1928.

CUCULIDAE

Piaya cayana thermophila Sclater

Additional specimens.— Almirante: 1 ♂, 7 November 1926; 1 ♀, 13 May 1927; 1 ♀, 10 June 1928; 1 ? July 1928. Isla Grande: 1 ♂, 18 July 1927. Bocas del Toro: 1 ♂, 31 October 1927.

Crotophaga sulcirostris sulcirostris Swainson

Additional specimens.— Changuinola: 1 ♂, 13 November 1927. Almirante: 1 ♂, 7 November 1926; 1 ♀, 13 May 1927.

RAMPHASTIDAE

Ramphastos sulphuratus brevicarinatus Gould

Additional specimens.— Changuinola: 1 ♀, 28 December 1926. Almirante: 1 ♂, 30 June 1927.

Rhamphastos swainsonii Gould

Additional specimens.— Almirante and vicinity: 1 ♀, 9 June 1926; 2 ♂, 22 April 1927. Guabo: 1 ?, 4 April 1928.

Pteroglossus torquatus torquatus (Gmelin)

Additional specimens — Almirante: 1 ♀, 7 August 1926; 1 ♀, 23 February; 1 ♂, 19 May; 1 ♀, 29 August 1927. Guabo: 1 ♂, 10 April 1928.

Selenidera spectabilis Cassin

Additional specimens.— Almirante: 1 ♂, 7 November 1928. Boquete trail, 1,200–3,500 feet: 1 ♂, 4 ♀, 16–29 March 1928.

GALBULIDAE

Galbula melanogenia Sclater

Additional specimens.— Guabo: 2 ♂, 13, 15 April 1928. Cricamola: 3 ♂, 1 ♀, 2 ?, 10–12 September 1927; 1 ♂, 13 February 1928; 3 ♂, 3 ♀, 1 ?, 10 July–26 August 1928.

Jacamerops aurea penardi Bangs and Barbour

Guabo: 1 ♀, 2 April 1928. Buena Vista (Boquete trail, 1,200 feet): 1 ♂, 12 March 1928.

Benson collected an example of this Jacamar at Bocas del Toro.

BUCCONIDAE

Bucco tectus subtectus P. L. Sclater

Almirante: 1 ♂, 1 November 1928.

This bird has usually been placed in the genus Notharchus but fits better, I believe, into *Bucco*.

Notharchus hyperrhynchus dysoni (P. L. Sclater)

Gerray Creek: 1 ♂, 19 December 1926. Almirante: 1 ♂, 5 May 1928; 1 ♂, 15 June 1928; 1 ♀, 18 January 1929.

Malacoptila panamensis costaricensis Cabanis

Guabo: 2 ♂, 3 April 1928. Boquete trail: 2 ♂, 14, 22 March 1928. Cricamola: 2 ♂, 2 ♀, 13, 16 February 1928; 2 ♂, 3 ♀, 8–25 August 1928.

The Malacoptila of northern and eastern Costa Rica and the Caribbean slope of northwestern Panama as far south as the eastern end of the Chiriqui Lagoon is referable to the race described as *Malacoptila costaricensis* by Cabanis in the Journal für Ornithologie, 1862, p. 172. No type locality was designated, but since the type was collected by v. Frantzius, eastern Costa Rica may be accepted as the type locality. *Costaricensis* is an intermediate form, but constant over a wide range; both the red and gray phases of plumage show good characters. Gray-brown phase: intermediate between *M. p. inornata* (DuBus) and *M. panamensis* Lafresnaye in color of pectoral band and intensity of the dark markings below. Red-brown phase: similar to *inornata* in being but faintly streaked below, but rufous of underparts deeper and more extensive than either *inornata* or *panamensis*. The ranges of the three Central American races of *Malacoptila panamensis* are (from north to south): *M. p. inornata* (Du Bus) from Guatemala and Salvador south probably to northern Nicaragua; *M. p. costaricensis* Cabanis, northern Nicaragua to northwestern Costa Rica (La Vijagua, 2 ♂ examined) and eastern Costa Rica (Carillo, 1 ♂ examined) south on the Caribbean slope to eastern end of Chiriqui Lagoon; *M. p. panamensis* Lafresnaye, southwestern Costa Rica (Terrabá Valley, 12 ♂, 10 ♀, examined) through northwestern Panama (Divala 8 ♂, 6 ♀) to the Canal Zone (4 specimens), Darien (1 ♂, 5 ♀, 1 ?) and western Colombia.

PICIDAE

Centurus pucherani pucherani (Malherbe)

Additional specimens.— Eleven from all localities.

Piculus simplex simplex (Salvin)

Kennard and Smith secured a single example of this rare woodpecker, but Wedel did not find it at all. On the other hand, Benson took four in the Almirante region. I am sorry not to be able to agree with Griscom as to the validity of his *aurorae* described from Almirante.

Celeus castaneus (Wagler)

Additional specimens.— Almirante: 1 ♂, 20 April 1927; 1 ♀, 1 ♂, 10 July, 22 November 1928. Guabo: 1 ♂, 2 ♀, 4, 6 April 1928. Changuinola: 1 ♀, 13 June 1928. Western River: 1 ♀, 27 June 1928. Cricamola: 1 ♀, 21 August 1928.

Celeus loricatus diversus Ridgway

Additional specimen.— Quebrada Nigua: 1 ♀, 1 November 1927.

Phlœoceastes melanoleucos malherbii (Gray)

Cricamola: 1 ♂, 11 August 1928.

Cricamola marks the westernmost point of the range of this woodpecker, though it has previously been recorded for western Panama from Veraguas, Cordillera de Tolé and Calovevora.

Phlœoceastes guatemalensis guatemalensis (Hartlaub)

Additional specimens.— Changuinola: 1 ♀, 25 January 1929. Almirante: 1 ♂, 20 April 1927. Western River: 1 ♀, 1 ?, 29 July, 29 September 1927. Guabo: 1 ♀, 4 April 1928. Boquete trail: 1 ♀, 27 March 1928.

Phlœoceastes haematogaster splendens (Hargitt)

Buena Vista (Boquete trail): 1 ♂, 17 March 1928.

This record extends the range of this bird from the Veraguas-Calovevora region where it was collected by Arcé, so that its known range now extends from the Chiriqui Lagoon, southward to northwestern Colombia (Antioquia).

Ceophloeus lineatus mesorhynchus Cabanis and Heine

Additional specimens.— Changuinola: 1 ♀, 29 September 1928. Fruitdale: 1 ♂, 7 May 1928.

FORMICARIIDAE

(The sequence of species here used in this family as well as in the Furnariidae and Dendrocolaptidae is that adopted by Hellmayr in parts 3 and 4 of the "Catalogue of Birds of the Americas.")

Cymbilaimus lineatus fasciatus Ridgway

Almirante: 1 ♀, 26 October 1926; 1 ♂, 1 ♀, 16 May, 15 June 1927; 1 ♂, 9 November 1928. Guabo: 2 ♂, 2 ♀, 9–15 April 1928.

Taraba transandeana transandeana (Sclater)

Additional specimens.— Changuinola: 1 ♂, 1 ♀, 30 September 1928. Near Almirante: 2 ?, 30 July, 21 December 1927; 1 ♀, 10 June 1928; 1 ♀, 18 January 1929. Cricamola: 1 ♂, 18 August 1928.

THAMNOPHILUS PUNCTATUS ATRINUCHA Salvin and Godman

Almirante and vicinity: 5 ♂, 5 ♀, 1 ?, 25 May 1927 to 26 January 1929. Guabo: 1 ♀, 3 April 1928. Cricamola: 1 ♂, 14 September 1927; 1 ♂, 15 August 1928.

THAMNISTES ANABATINUS SATURATUS Ridgway

Boquete trail (3,500 feet): 1 ♂, 27 March 1928.

The single specimen secured by Wedel is strictly referable to *saturatus*, as are two males in the Museum of Comparative Zoölogy collec-lections secured at 2,000 feet on the Caribbean slope of the Volcan de Chiriqui by W. W. Brown, 13 June 1901. On the other hand, Griscom (mss.) refers nine examples in the American Museum, collected on the Rio Calovevora by Benson in the summer of 1926, to *T. a. coronatus* Nelson.

DYSITHAMNUS PUNCTICEPS PUNCTICEPS Salvin

Boquete trail (2,000 feet): 1 ♂, 25 March 1928.

This bush bird appears to be a rare species as far west as the Chiriqui Lagoon. In addition to the single specimen secured by Wedel, Benson shot one near Almirante. Further east it appears to be common; Benson amassed a series of nineteen on the Rio Calovevora.

MYRMOTHERULA FULVIVENTRIS Lawrence

Boquete trail (2,000 feet): 1 ♂, 25 March 1928.

This species exhibits a considerable range of color variation even in birds from the same locality. The birds inhabiting Costa Rica have been formally recognized by Mr. Todd as a distinct subspecies under the name of *M. f. costaricensis* (Proc. Biol. Soc. Wash., **40**, 1927, p. 156), but in the opinion of the present writer the claim of this form to recognition should be denied.

MYRMOTHERULA AXILLARIS ALBIGULA Lawrence

Boquete trail (2,000 feet): 1 ♂, 25 March 1928. Almirante: 1 ♂, 1 November 1928.

MICRORHOPIAS BOUCARDI VIRGATA (Lawrence)

Boquete trail (1,300 feet): 1 ♀, 19 March 1928.

I believe that Chapman is entirely correct in his views regarding the specific distinctness of *boucardi* and *quixensis*.

Myrmeciza exsul exsul Sclater

Almirante: 1 ♂, 26 May 1927. Cricamola: 3 ♂, 1 ♀, 15–23 August 1928.

Formicarius analis umbrosus Ridgway

Almirante: 1 ♂, 24 May 1927; 1 imm. ♂, 17 July 1928. Guabo: 2 ♂, 1 ?, 4–9 April 1928. Buena Vista: 1 ♂, 23 March 1928.

This race of the rufous-vented ant thrush has not been previously recorded from Panama, though having been originally described from the Talamanca Valley in Costa Rica, it is the form that would naturally occur in the adjacent part of Panama.

Formicarius nigricapillus nigricapillus Ridgway

Boquete trail (1,500 feet): 1 ♂, 24 March 1928.

Gymnopithys bicolor bicolor (Lawrence)

Boquete trail (1,500 feet): 1 ♀, 17 March 1928.

This single specimen is doubtless referable to *b. bicolor*. It tends very slightly to intermediacy in that the forehead is only very narrowly gray, nor is that color on the sides of the head as extensive as in topotypical examples, nevertheless the bird so much more nearly approximates *b. bicolor* than *b. olivascens* that I have no hesitation in referring it to the former race. Griscom (mss.) received six specimens from Benson, collected on the Rio Calovevora.

Gymnopithys bicolor olivascens (Ridgway)

Griscom's manuscript list of the birds taken at Almirante by Benson enumerates three specimens of this subspecies.

Hylophylax naevioides capnitis (Bangs)

Guabo: 1 ♂, 8 April 1928.

The subspecies of *H. naevioides* of this region proves, as was to be expected, clearly referable to the race described by Bangs from Miravalles, Costa Rica. It is the first record of its occurrence in Panama. Hellmayr (Cat. Birds. Am., **3**, 1924, p. 308) in defining the range of *capnitis* appears to have overlooked the fact that Carriker (Ann. Carn. Mus., **6**, nos. 2–4, 1910, p. 619–620) records it as occurring in northwestern Costa Rica where it is abundant. Specimens taken by Benson on the Rio Calovevora have been listed by Griscom (mss.)

as of this race; thus it would appear that the form inhabits the Pacific lowlands of northwestern Costa Rica and the Caribbean lowlands from at least the Rio Escondido, Nicaragua, south and east to the Rio Calovevora, Panama. When series of *H. n. naevioides* and *H. n. capnitis* are compared, the much deeper gray flanks of the males of the latter are very noticeable.

Phaenostictus mcleannani saturatus (Richmond)

Boquete trail (1,300 feet): 1 ♂, 21 March 1928.

This bird agrees with examples of *saturatus* from Costa Rica, and furnishes further proof, if any more be needed, of the close faunal affinity between Almirante Bay–Chiriqui Lagoon region and that of eastern Costa Rica. This form is an addition to the avifauna of Panama.

The American Museum possesses a series of eleven specimens of *P. m. mcleannani* from the Rio Calovevora (Griscom, mss.).

Pittasoma michleri zeledoni Ridgway

Almirante: 1 ♂, ♀, 1 November 1928.

This pair of ant-pittas is decidedly intermediate between true *michleri* of eastern Panama and *m. zeledoni* of eastern Costa Rica; perhaps a better series and more comparative material would prove the existence of a good intermediate form in western Panama. For the present, however, I refer the birds to *zeledoni*, which they approach in size: ♂ wing 102; ♀, wing 99. The male is completing a wing moult, the inner six primaries being entirely new, the seventh not fully grown, and the three outer ones yet unshed: the female shows a similar condition, but is one primary behind, *i.e.* the sixth is the one not fully grown out. The wing lengths here given are full value, since the fourth or fifth primary is the longest in this species.

Grallaria guatimalensis princeps Sclater and Salvin

Boquete trail (3,500 feet): 1 ♂, 29 March 1928.

Grallaria fulviventris flammulatus (Griscom)

This form was described by Griscom (Am. Mus. Novit., no. 293, 1928, p. 4) from Almirante, whence Benson sent two males to the American Museum. The species was not met with by either Kennard and Smith or Wedel.

Grallaria perspicillata intermedia Ridgway

Cricamola: 1 ♂, 19 August 1928.

The one example secured by Wedel is certainly *intermedia,* but shows a slight approach to *p. perspicillata* in having traces of black streaking, on the flanks. From Cricamola to the Rio Calovevora the transition from one form to the other must be rapid, since at the latter locality, fifty miles to the eastward true *perspicillata* occurs (fide Griscom mss.).

FURNARIIDAE

Synallaxis brachyura nigrifumosa Lawrence

Additional specimens.— Changuinola: 1 ♀, 4 October 1928. Almirante: 5 ♂, 1 ♀, 1 ?, 3 May 1927 to 17 July 1928. Cricamola: 1 ?, 14 August 1928.

Automolus ochrolaemus hypophaeus Ridgway

Almirante: 1 ♂, 12 November 1928. Boquete trail: 1 ♂, 2 ?, 13, 14 March, 1 April 1928.

Xenops minutus ridgwayi Hartert and Goodson

Almirante· 2 ♂, 3 ♀, 1 ?, 31 May 1927 to 21 September 1928. Cricamola: 1 ♂, 22 September 1927.

Sclerurus guatemalensis guatemalensis (Hartlaub)

Found only by Benson who took a specimen at Bocas del Toro (Griscom mss.).

DENDROCOLAPTIDAE

Dendrocolaptes certhia sancti-thomae (Lafresnaye)

Changuinola: 1 ♂, 25 January 1929. Almirante: 2 ♂, 1 ♀, 25 May to 10 June, 1927; 1 ♀, 16 January 1929. Boquete trail: 1 ♂, 16 March 1928. Cricamola: 2 ♀, 22, 24 August 1928.

Xiphorhynchus guttatus costaricensis (Ridgway)

Additional specimens.— Changuinola: 1 ♂, 28 December 1926; 1 ♂, 1 ♀, 29 September to 4 October 1928. Almirante: 1 ♂, 16 May; 1 ♀, 16 June 1927; 2 ♂, 19 January, 1 June 1928. Western River: 1 ♀, 12 July 1928. Guabo: 1 ♂, 3 April 1928.

Xiphorhynchus guttatus nanus (Lawrence)

Cricamola: 1 ♀, 13 August 1928.

The single bird from Cricamola cannot be referred to *costaricensis*. Compared with summer birds from Almirante, it is much paler, especially below, with the throat nearly white; in fact, it is paler than seasonably comparable specimens of topotypical *nanus*.

Xiphorhynchus lachrymosus lachrymosus Lawrence

Additional specimens. — Almirante: 1 ♂, 29 May 1927. Boquete trail (1,200–1,400 feet): 2 ♂, 1 ♀, 15–22 March 1928.

Kennard and Peters recorded birds from Almirante and Boquete Trail under the name of *X. l. eximius* Hellmayr. The receipt of the material listed above together with other specimens since received convinces me that differences claimed to exist between *eximius* and *lachrymosus* are not correlated geographically, and I no longer recognize the former subspecies as distinct.

Lepidocolaptes souleyetii compressus (Cabanis)

Almirante: 2 ♂, 2 ♀, 25 May 1927 to 3 May 1928. Changuinola: 1 ♂, 18 October 1929; 1 ?, 28 January 1929.

Though perhaps only a coincidence, it is at least worthy of remark that there seems to be a wide gap in the range of *L. souleyetii* on the Caribbean slope of Panama. In eastern Central America, *L. s. compressus* ranges from Nicaragua to Panama, where specimens from Almirante mark its nearest approach to the Canal Zone. From Almirante to Lion Hill, where the range of *L. s. lineaticeps* begins, the species is unrecorded.

Perhaps further field work will reveal the presence of the bird in the intervening area, but it is extremely significant that neither Kennard and Smith nor Wedel met with it on the shores of the Chiriqui Lagoon nor in the forests along the Boquete trail. Benson did not find it on the Calovevora, but both Benson and Wedel secured it at Almirante. The same hiatus, I believe, exists on the Pacific slope from Chiriqui to the Canal Zone.

Glyphorhynchus spirurus sublestus Peters

Changuinola: 1 ♂, 16 October 1928. Almirante: 1 ♀, 30 June 1927. Western River: 1 ♀, 6 October 1928. Buena Vista: 1 ♀, 25 March 1928. Cricamola: 3 ♂, 15, 19 August 1928.

Dechonychura typica minor Todd

Benson was so fortunate as to secure a specimen of this rare bird at Almirante. Griscom records it in American Museum Novitates, no. 293, p. 1.

Dendrocincla meruloides ridgwayi Oberholser

Additional specimen.— Cricamola: 1 ♂, 18 August 1928.

TYRANNIDAE

The sequence here followed is that of Hellmayr (Cat. Birds Amer., pt. 5, 1927.)

Colonia colonus leuconota (Lafresnaye)

Additional specimen.— Almirante: 1 ♂, 18 July 1928.

Tyrannus tyrannus (Linné)

Almirante: 1 ♂, 22 April 1927. Guabo: 1 ♂, 3 April 1928; 1 ♀, 11 October 1928.

Tyrannus melancholicus chloronotus Berlepsch

Additional specimens.— Almirante: 2 ♂, 29 August 1927. Cricamola: 1 ♀, August 1928.

Megarynchus pitangua mexicanus (Lafresnaye)

Cricamola: 1 ♂, 6 August 1928.

Myiozetetes granadensis granadensis Lawrence

Almirante: 1 ♂, 1 imm. ♀, 13, 26 May 1927.

Pitangus sulphuratus guatimalensis (Lafresnaye)

Additional specimens.— Changuinola: 1 ♀, 27 October 1927. Almirante: 1 ♂, 2 ♀, 7–18 May 1927; 1 ?, 12 November 1928.

While *Pitangus sulphuratus* enjoys a wide distribution in Central and South America, it is absent from Panama except on the Caribbean slope in the western portion, where it extends only to the western shores of Almirante Bay.

Myiarchus crinitus (Linné)

Additional specimens.— Almirante: 1 ♀, 15 April 1927. Quebrada Nigua: 1 ?, 3 November 1927.

Myiarchus tuberculifer bangsi Nelson

Additional specimens.— Almirante: 1 ♂, 10 June 1927; 1 ♀, 18 July 1928.

Nuttallornis mesoleucus mesoleucus (Lichtenstein)

Benson took a specimen of the Olive-sided Flycatcher at Almirante.

Myiochanes virens (Linné)

Almirante: 1 ♀, 17 April 1927. Cricamola: 1 ♂, 21 September 1927.

Empidonax flaviventris (Baird and Baird)

Boquete trail: 1 ?, 19 March. Guabo: 1 ♂, 13 April 1928.

Empidonax virescens (Vieillot)

Changuinola: 1 ♂, 1 ♀, 16, 18 October 1927. Guabo: 1 ?, 3 November 1927.

Empidonax traillii brewsteri Oberholser

Almirante: 1 ♂, 1 ?, 17, 22 September 1928. Cricamola: 1 ♀, 17 February 1928.

Terenotriccus erythrurus fulvigularis (Salvin and Godman)

Banana River: 1 ♂, 17 July 1928.

Also taken near Almirante by Benson.

Myiobius atricaudus atricaudus Lawrence

Almirante: 1 ♂, 4 August 1927.

This specimen appears to constitute the northernmost record for this flycatcher on the Caribbean slope of Central America. On the Pacific slope it ranges as far north as the Gulf of Nicoya.

Todirostrum nigriceps Sclater

Benson collected three examples of this rare Todirostrum at Almirante.

Todirostrum cinereum finitimum Bangs

Additional specimens.— Almirante: 4 ♂, 1 ♀, 4 May to 8 June 1927. Cricamola: 1 ♂, 22 August 1928.

Todirostrum sylvia schistaceiceps Sclater

Almirante: 1 ♂, 8 June 1927.

Oncostoma cinereigulare (Sclater)

Benson took five Bent-billed Flycatchers at Almirante, but the bird was not found by the other collectors.

Lophotriccus pileatus luteiventris (Taczanowski)

Boquete trail: 1 ♂, 17 March 1928.

Tyranniscus vilissimus parvus Lawrence

Almirante: 1 ♂, 18 May 1927. Cricamola: 1 ♂, 22 August 1928.

Pipromorpha assimilis assimilis Sclater

Changuinola: 1 ♂, 18 October 1928. Almirante: 1 ♀, 26 June; 1 ♂, 5 August 1927. Guabo: 2 ♂, 7, 8 April 1928.

The Caribbean slope race of *P. assimilis* was first recorded from Panama by Griscom (1928), on the basis of ten examples collected by Benson at Almirante.

PIPRIDAE

Pipra mentalis ignifera Bangs

Additional specimens.— Changuinola: 1 ?, 4 October 1928; 1 ♂, 13 June 1929; 1 ?, 1 ♀, 4, 15 October; 1 imm. ♂, 31 December 1928; 1 ♂, 13 June 1929. Almirante: 1 ♂, 26 February; 2 ♂, 15, 20 April 1927; 1 ♂, 15 November 1928. Boquete trail: 2 ♂, 14, 23 March 1928. Cricamola: 1 ?, 15 August 1928.

Pipra velutina velutina Berlepsch

Cricamola: 1 ♂, 1 ♀, 19, 21 August 1928.

Manacus cerritus Peters

Almirante and Changuinola: 23 specimens, both sexes, 5 May 1927 to 18 January 1929.

Additional material received since the species was described shows that the yellow of the underparts, instead of always extending over the

flanks and abdomen, is sometimes restricted to the throat and breast, leaving the posterior underparts greenish olive.

When I first described this species I believed its closest affinities to be with *aurantiacus*. I am now convinced that *cerritus* is more nearly related to *candei*, from which it differs instantly in having the throat, broad nuchal and scapular areas and lesser wing coverts yellow instead of white; the throat feathers are of about the same length in both species. *Aurantiacus* in color is an intensified *cerritus*, but is a considerably smaller bird. *Vitellinus*, with its black wing coverts, narrow yellow collar and much more elongated throat feathers, is a very different bird from either.

Manacus cerritus has a very limited range; birds from the Talamanca Valley in southeastern Costa Rica are *candei*, showing no approach whatever to *cerritus*, while at Cricamola the next species is found.

Manacus vitellinus vitellinus (Gould)

Cricamola: 1 ♂, 26 August 1928.

Corapipo leucorrhoa altera Hellmayr

Additional specimen.— Boquete trail: 1 ♂, 30 March 1928.

[It is very interesting to note that none of the collectors operating about Almirante secured *Schiffornis turdinus veraepacis* Scl. and Salv.]

COTINGIDAE

Tityra semifasciata costaricensis Ridgway

Additional specimens.— Almirante, Western River, Quebrada Nigua, Chiriquicito, Cricamola: 17, both sexes, 6 May 1927 to 18 July 1928.

Erator albitorques fraseri (Kaup)

Additional specimens.— Almirante: 7 ♂, 2 ♀, 11 February to 24 August 1927. Isla Grande: 1 ♂, 23 June 1928. Guabo: 1 ♂, 15 April 1928. Cricamola: 1 ♀, 15 February; 1 ♂, 2 ♀, 12–26 August 1928.

Pachyrhamphus cinnamomeus Lawrence

Almirante: 1 ♂, 1 ♀, 5, 9 May 1927; 1 ♂, 1 ♀, 1 ?, 13 July 1928. Guabo: 1 ♂, 3 April 1928. Cricamola: 1 ♂, 17 February; 1 ♂, 1 ♀, 1 ?, 9–20 August 1928.

Pachyrhamphus polychopterus cinereiventris Sclater

Almirante: 1 ♂, 1 ♀, 31 May, 21 July 1927. Western River: 1 ♀, 12 July 1928. Chiriquicito: 1 ♀, 27 April 1928.

Lipaugus unirufus castaneotinctus (Hartert)

Almirante: 2 ♀, 16 April, 29 June 1927.

Rhytipterna holerythra holerythra (Sclater and Salvin)

Additional specimens.— Almirante: 1 ♂, May 1928. Buena Vista: 1 ♂, 1 ♀, 16 March 1928. Boquete trail: 1 ♂, 2 ♀, 17, 20, 30 March 1928.

Attila citreopyga citreopyga (Bonaparte)

Almirante: 1 ♀, 16 April 1927; 2 ♂, 1 ?, 1–20 June 1928. Guabo: 2 ♂, 1 ♀, 10, 11 April 1928. Cricamola: 1 ♂, 16 February 1928.

Carpodectes nitidus Salvin

Additional specimens.— Almirante: 2 ♂, 3, 26 May; 3 ♂, 3 ♀, 1 ?, 3, 4, 29 August 1927; 1 ♂, 31 August 1928.

Querula purpurata (Müller)

Additional specimens.— Almirante, 3 ♂, 3 ♀, 19, 23 February, 15 June 1927. Western River: 3 ♂, 1 ♀, 5 October 1927, 12 May, 12 July 1928. Zegla: 1 ♀, 16 December 1927. Guabo: 2 ♂, 5 April 1928. Cricamola: 2♂, 1 ♀, 17 February, 20, 26 August 1928.

Procnias tricarunculata (J. and E. Verreaux)

Additional specimens.— Changuinola: 1?, 13 August 1927. Almirante: 1 ♂, 2 ♀, 17, 18 December 1928.

HIRUNDINIDAE

Iridoprocne albilinea (Lawrence)

Changuinola: 1 ♂, 17 June 1928.

Hirundo rustica erythrogaster Boddaert

Almirante: 1 ♀, 21 October 1926; 1 ♂, 9 November 1927.

Progne chalybea chalybea (Gmelin)

Additional specimens.— 1 ♂, 1 ♀, Swan Key, 3 June 1927.

Stelgidopteryx ruficollis uropygialis (Lawrence)

Cricamola: 1 ♂, 16 August 1928.

SYLVIIDAE

Ramphocaenus rufiventris rufiventris (Bonaparte)

Almirante: 1 ♂, 1 ♀, 31 May, 26 July 1927. Boquete trail (1,500–3,500 feet): 1 ♂, 1 ?, 17, 29 March 1928. Cricamola: 1 ?, 22 September 1927.

Microbates cinereiventris semitorquatus (Lawrence)

Benson collected a single specimen at Almirante, the only record for the Chiriqui Lagoon region.

Polioptila superciliaris superciliaris (Lawrence)

Additional specimen.— Western River: 1 ♂, 12 May 1928.

TROGLODYTIDAE

Heleodytes zonatus costaricensis (Berlepsch)

Cricamola: 7 ♂, 3 ♀, 1 ? (adults and immature), 13 August, 9, 12 September 1927, 12, 13 February, 14–23 August 1928.

Benson also collected this bird at Bocas del Toro and at Almirante. I have had occasion to make direct comparison between the series from Cricamola and the birds taken by Benson as well as with topotypical *costaricensis* and the type series of *H. z. panamensis* Griscom from Santa Fé, Veraguas. The four specimens from Almirante and Bocas are without doubt strictly referable to *costaricensis*. Two February specimens (least worn of the series) from Cricamola approach *panamensis* in having slightly deeper coloration on the posterior underparts, but agree with *costaricensis* in the somewhat larger size of the dark areas on the pileum and lack of any distinct buffy wash on the hind neck; they are best placed with *costaricensis*.

Thryophilus zeledoni Ridgway

Additional specimen.— Almirante: 1 ♀, 10 August 1927.

Benson took three more, one at Bocas and two at Almirante.

Thryophilus thoracicus (Salvin)

Almirante: 1 ♂, 22 May 1927.

THRYOPHILUS CASTANEUS COSTARICENSIS (Sharpe)

Additional specimens.— Twenty-one, from nearly all localities in the Chiriqui Lagoon region.

As Kennard and Peters have already pointed out, the bay wrens from the region about Almirante are clearly referable to *costaricensis*. A series of six from Cricamola (2 ♂, 10, 21 September 1927 and 3 ♂ and 1 ?, 8–16 August 1928) while best referred to *costaricensis*, show an approach towards *castaneus*, not sufficient however to warrant the naming of a very slightly differentiated intermediate race, whose range would turn out to be very small, since according to Griscom (mss.) *T. c. castaneus* is the bird occurring in the Rio Calovevora district.

The original conception of a subspecies was a geographic aggregate of individuals connected by a series of actual intergrades to the next geographic aggregate of the same species. More recently this conception has been broadened, so as to regard representative forms as subspecies, even though actual intergradation does not occur; though some systematists demand intergradation through individual variation before being willing to regard as subspecies two more or less widely separated forms.

It is perfectly obvious that in cases of species having continuous distribution, and divisible into a number of well-marked geographic races, there are bound to be areas of intergradation between the races in which the birds might be referred, some to one adjoining race and some to the other. Of late years with the number of really good geographical subspecies to be named already discriminated, and with a fairly large crop of systematists still at work and anxious to "name something," it is only natural that these intergrading groups of individuals have begun to claim more than their share of attention. It is, of course, an impossibility to lay down a set of rules that will cover any given case. My own practice is to avoid naming intermediates between closely drawn subspecies. Neither does it seem to me to be advancing the science of ornithology to split up a species on "average" characters.

PHEUGOPEDIUS ATROGULARIS (Salvin)

Additional specimens.— Almirante: 1 ♀, 4 November 1926; 1 ♂, 4 November 1927. Western River: 1 ♂, 30 September 1927.

TROGLODYTES MUSCULUS INTERMEDIUS Cabanis

Chiriquicito: 1 ♂, 27 August 1928.

The above skin is that of a bird in worn summer plumage. It differs, however, from a pair of adults from Cricamola (see below), both in a

similar state of wear, in being more buffy brown below and on the sides of the head; characters that place it with *intermedius*.

Troglodytes musculus inquietus Baird

Cricamola: 1 ♂, 1 ♀, 13, 14 August 1928.

Henicorhina prostheleuca tropaea Bangs and Peters

Almirante: 1 ♂, 1 ♀, 31 May, 15 June 1927. Cricamola: 1 ♂, 21 August 1928.

Cyphorhinus phaeocephalus lawrencii Sclater

Almirante: 1 ♀, 26 May 1927.

Under the International Code the genus *Leucolepis* must give way to *Cyphorhinus* Cabanis 1844, since that name is not preoccupied by *Cyphorhina* Lesson 1843.

MIMIDAE

Dumetella carolinensis (Linné)

Changuinola: 1 ?, 2 December 1927. Almirante: 1 ♀ 1 ?, 2, 20 November 1927; 1 ♀, 16 January 1929.

TURDIDAE

Turdus grayi casius (Bonaparte)

Additional specimens.— Changuinola: 1 ♂, 21 January 1929. Almirante: 1 ♂, 16 February; 1 ♂, 19 April; 1 juv. ♂, 1 ♀, 10, 14 June 1929. Western River: 1 ♀, 12 May 1928. Guabo: 1 ♂, 6 April 1928. Chiriquicito: 2 ♀, 17, 18 April 1928. Cricamola: 1 ?, 13 August 1928.

Hylocichla mustelina (Gmelin)

Changuinola: 1 ?, 31 December 1928. Almirante: 1 ?, 30 October 1926; 1 ♀, 1 November 1928.

Hylocichla ustulata swainsoni (Tschudi)

Changuinola: 1 ♀, 15 October 1928. Almirante: 1 ♂, 21 October 1927. Guabo: 2 ♀, 6, 9 April 1928.

Catharus mexicanus fumosus Ridgway

Boquete trail: 2 ♂, 21, 27 March 1928.

VIREONIDAE

Vireo virescens Vieillot

Boquete trail: 1 ?, 22 March 1928. Cricamola: 2 ♂, 1 ?, 10, 21, 22 September 1927.

Vireo flavoviridis flavoviridis (Cassin)

Changuinola: 1 ♂, 27 September 1927.

This single specimen is the only record for the Chiriqui Lagoon region; the bird is without doubt a migrant.

Hylophilus decurtatus pusillus Lawrence

Almirante: 1 ♂, 25 May 1927. Boquete trail: 1 ♂, 17 March 1928.

MNIOTILTIDAE

Mniotilta varia (Linné)

Changuinola: 1 ♀, 30 September 1928.

Protonotaria citrea (Boddaert)

Miscellaneous localities near Almirante: 3 ♂, 2 ?, 1–20 October 1927; 1 ♀, January 1929. Cricamola: 2 ♂, 17, 22 September 1927. Changuinola: 1 ♀, 25 January 1929.

A common winter visitant.

Dendroica aestiva aestiva (Gmelin)

Additional specimens.— Almirante: 1 ♂, 1 ♀, 31 August, 27 September 1927; 1 ♂, 3 May 1928; 1 ♀, 13 August 1928.

Dendroica aestiva rubiginosa (Pallas)

Griscom (ms.) cites two examples of this subspecies of the Yellow Warbler taken by Benson at Almirante.

Dendroica erithachorides erithachorides Baird

Almirante: 5 ♂, 3 ♀, 1 ?, 18 May, 14 July, 4, 22 August 1927; 10 July, 14 September 1928; 18 January 1929. Quebrada Nigua: 1 ♂, 15 January 1929. Shepherd Island: 1 ♂, 1 ♀, 17 May 1928. Western River: 3 ♂, 1 ♀, 1 ?, 24 July, 2 August, 5 October 1927. Cricamola: 1 ♀, 12 February 1928.

These birds are certainly not referable to *bryanti*, since they are more heavily and boldly streaked below. A comparison with the type of

Dendroica erithachorides Baird from Carthagena, Colombia has been possible through the courtesy of the authorities of the United States National Museum. This comparison fails to reveal any tangible character by which the birds from about Almirante Bay may be separated from the form known to inhabit the northern coast of Colombia. At this point it may not be out of place to hazard the suggestion that *erithachorides* will eventually be found in suitable mangrove swamps the length of the Caribbean shores of Panama.

Birds from the Pacific side of the Canal Zone and from the Pearl Islands have always been referred to *erithachorides,* but are not the same as the specimen from Carthagena. The latter has the chestnut head sharply defined from the rest of the yellow underparts, whereas the Pearl Island specimens have the streaks on the upper part of the breast very broad and coalescent with the posterior border of the throat patch.

Gyldenstolpe (Ark. Zoöl., **19** A, no. 1, 1926, p. 31) has already shown that the type of *Dendroica petechia acquatorialis* Sundevall, supposed to have come from Guayaquil, is identical with specimens from the Pearl Islands, but believing birds from that archipelago to be true *erithachorides,* disposed of *aequatorialis* as a synonym. In a final effort to straighten out the matter I wrote to Dr. Lönnberg to learn more of the history of the type of *aequatorialis;* he replies in part as follows: " . . . but in the handwritten catalogue recording the birds brought home by Eugenie the following words are written by Sundevall himself concerning this specimen: 'Guayaquil eller Panama, April, which translated means Guayaquil or Panama April.' Eugenie visited both Guayaquil and Panama in April, but left the former place the fifth if I remember rightly. With this record of uncertainty concerning the exact place where Sundevall's specimen was collected, I think that there is no danger in assuming that it really was collected at Panama, especially as this agrees with the appearance of the bird and other facts."

I therefore designate Panama City, Panama as the type locality of *Dendroica petechia aequatorialis* Sundevall, a procedure that is in accordance with the facts, and one which involves no change in nomenclature other than resurrecting the name. Unfortunately the bird of the Pacific end of the Canal Zone and the Pearl Islands becomes *acquatorialis.* I only wish I could believe that this further example of how geographic names can become misnomers would not pass unheeded, but with the general decline of the study of the classics in this day and generation, I can only anticipate an even more general display of ignorance and its resulting "hog latinization" of nomenclature.

Since the determination of the proper name for both the Almirante and Pearl Island series of mangrove warblers has involved an unexpected amount of correspondence and research, it may be well to place on record a few of the facts gathered in regard to the races, ranges and principal synonymy.

Dendroica erithachorides castaneiceps Ridgway

Dendroica bryanti castaneiceps Ridgway, Proc. U. S. Nat. Mus., **8**, 1885, p. 350, footnote (La Paz, Lower California, type in U. S. Nat. Mus.).

Mangrove swamps, Pacific coast of Mexico (Mazatlan) and lower California (lat. 27°) south to Guatemala.

Dendroica erithachorides xanthotera Todd

Dendroica bryanti xanthotera Todd, Proc. Biol. Soc. Wash., **37**, 1924, p. 123 (Punta Arenas, Costa Rica, type in Carnegie Mus.).

Mangrove swamps of the Pacific coast of Central America from Guatemala to Costa Rica (Punta Arenas).

Dendroica erithachorides bryanti Ridgway

Dendroica vieillottii var. *bryanti* Ridgway, Am. Nat., **7**, 1873, p. 605 (Belize, British Honduras, type in U. S. Nat. Mus.).

Mangroves and salt water growths on the Gulf coast of Mexico from Tampico south on the Caribbean coast of Central America to Port Limon, Costa Rica.

Dendroica erithachorides erithachorides Baird

Dendroica erihtachorides (sic) Baird, Rep. Pac. R. R. Survey, **9**, 1858, p. 283, in text (Carthagena, Colombia. Type in U. S. Nat. Mus.).

Dendroica Vieilloti Cassin, Proc. Ac. Nat. Sci., 1860, p. 192 (Carthagena, type in U. S. Nat. Mus., the same specimen as Baird's type of *erithachorides!*).

Rhimamphus ruficeps Cabanis, J. f. O., 1860, p. 326 (Carthagena,[1] type in Berlin Mus.).

Dendroeca petechia i *panamensis?* Sundevall, Öfv. K. Vet.-Akad. Förh. Stockholm, **26**, 1869 (1870), p. 609 (renaming of *vieilloti* Cass.).

Almirante Bay and Chiriqui Lagoon region of Panama and northern coast of Colombia from Carthagena to the Cienaga Grande.

[1] Dr. Streseman writes me as follows: "I believe Cabanis based his diagnosis of *Rhimamphus ruficeps* on the specimens possessed at the time by the Berlin Museum, namely 'einige ... Examplare dieser Art aus der Küstengegend von Neu-Granada (von Carthagena), und ein aus der alten Bullock'schen Sammlung stammendes Exemplar,' all of which are still preserved in our museum. I, therefore, believe to be justified in making a type, Carthagena, Haeberlin leg. (Berlin Mus. no. 4,458)."

Dendroica erithachorides aequatorialis Sundevall

Dendroica erithachorides auct. nec Baird.

Dendroeca petechia h. *aequatorialis* Sundevall, Öfv. K. Vet.-Akad. Förh. Stockholm, **26**, 1869 (1870), p. 609, Guayaquil. Error = Panama City (type in Royal Nat. Hist. Mus., Stockholm).

Pearl Islands and adjacent mainland of Panama.

The bird described as *Dendroeca granadensis* by Sharpe (Cat. Birds Brit. Mus., **10**, 1885, p. 284, Colombia) has, so far as I am aware, never been satisfactorily identified. It may refer to *Dendroica petechia peruviana* in the very high plumage referred to by Chapman (Bull. Am. Mus. Nat. Hist., **36**, 1917, p. 545) or perhaps was based on worn or bleached examples of *erithaehorides*. The bird described by Sharpe (l. c., p. 283) as *vieilloti* from a specimen from Gorgona Island, collected by Kellett and Wood, is probably the same as *aequatorialis*, but the description is so detailed in the inconsequential characters and the chief characters misunderstood, that positive identification is impossible without examination of the type.

Dendroica fusca (Müller)

Boquete trail: 1 ♀, 26 March, 1928.

Dendroica pensylvanica (Linné)

Almirante: 1 ♀, 12 November; 2 ♂, 29 December 1928. Boquete trail: 1 ♂, 23 March 1928. Cricamola: 1 ♂, 22 September 1927.

Oporornis formosa (Wilson)

Changuinola: 1 ♂, 4 October 1928.

Oporornis philadelphia (Wilson)

Almirante: 1 ♂, 12 October 1928. Guabo: 1 ♂, 12 April 1928.

Seiurus motacilla (Vieillot)

Cricamola: 1 ♂, 24 August 1928.

Seiurus noveboracensis notabilis Ridgway

Changuinola: 1 ?, 1 ♀, 30 September, 4 October, 1928. Almirante: 1 ♂, 12 December 1928. Quebrada Nigua: 1 ♂, 14 January 1929.

Geothlypis semiflava bairdi Nutting

Additional specimens.— Changuinola: 2 ♂, 1 ♀, 17 June, 30 September, 7 November 1928. Almirante: 1 ?, 21 June 1928. Isla Grande: 1 ♂, 31 December 1927.

Icteria virens virens (Linné)

Almirante: 1 ♂, 16 January 1929.

Wilsonia canadensis (Linné)

Changuinola: 1 ?, 3 October 1927; 1 ?, 15 October 1928. Almirante: 1 ♀, 22 September 1928.

Setophaga ruticilla (Linné)

Almirante: 2 ♂, 27, 31 August 1927; 2 ?, 14, 22 September 1928.

Phaeothlypis leucopygia leucopygia (Sclater and Salvin)

Western River: 1 ♂, 19 November 1927. Guabo: 3 ♂, 4, 9, 13 April 1928.

I have followed Todd in his recent treatment of this species which was formerly included in the genus *Basileuterus*. (Proc. U. S. Nat. Mus., **74**, art. 7, 1929, pp. 1–95.)

FRINGILLIDAE

Pheucticus tibialis Lawrence

Additional specimens.— Guabo: 1 ♂, 30 March 1928. Boquete trail: 1 ♂, 1 ?, 17, 21 March 1928.

Guiraca caerulea caerulea (Linné)

Almirante: 1 ♀, 1 December 1926.

This single specimen, apparently a bird of the year, is referred provisionally to the eastern blue grosbeak. It must be borne in mind that the identification of immature migrants of closely drawn races, especially when far beyond the normal range of subspecies, is always a matter of more or less uncertainty.

Cyanocompsa cyanoides caerulescens Todd

Additional specimens.— Changuinola: 1 ♂, 3 December 1928. Western River: 1 ♂, 27 June 1928. Almirante: 1 ♂, 24 January 1929.

Oryzoborus funereus Sclater

A species secured by Benson both at Bocas del Toro and Almirante, but strangely enough, not found by the other collectors.

Volatinia jacarini atronitens Todd

Another common, widespread species that was overlooked by all except Benson, who took it at Almirante.

Pitylus grossus saturatus Todd

Guabo: 1 ♂, 8 April 1928. Cricamola: 2 ♂, 26 August 1929.

Caryothraustes poliogaster scapularis (Ridgway)

Additional specimens.— Almirante: 1 ♂, 14 June 1927; 2 ♂, 1 June 1928. Boquete trail: 1 ♀, 27 March 1928.

Saltator atriceps lacertosus Bangs

Additional specimens.— Almirante: 1 ♂, 13 May 1927. Guabo: 1 ♂, 8 April 1928.

Saltator maximus magnoides Lafresnaye

Additional specimens.— Almirante: 2 ♂, 22 May, 14 June 1927; 2 ♂, 2 ♀, 1, 15 June, 13 July 1928. Guabo: 1 ♀, 12 April 1928. Cricamola: 1 ♀, 14 August 1928.

This bird was previously recorded by Kennard and Peters as *Saltator magnoides medianus* Ridgway. For the reasons for the change of both specific and subspecific name the reader is referred to Griscom, Bull. Mus. Comp. Zoöl., **69**, no. 8, 1929, p. 184 and to Peters, *op. cit.*, no. 12, pp. 467–468.

Spiza americana (Gmelin)

Additional specimens. Chiriquicito: 1 ♂, 1 ?, 17, 18 April 1928.

Arremonops striaticeps richmondi Ridgway

Additional specimens.— Changuinola: 1 ♂, 13 July 1928. Almirante: 1 ♀, 3 February; 1 ♂, 30 April; 2 ♂, 1 juv., 19, 26, 27 May; 1 ♀, 2 November 1927; 2 ♂, 5, 31 May; 1 ♀, 26 July 1928. Quebrada Nigua: 1 ♂, 14 January 1929.

Arremon aurantiirostris rufidorsalis Cassin

Boquete trail: 1 ♂, 1 ♀, 19–21 March 1928. Guabo: 1 ♂, 1 ♀, 4 April 1928. Cricamola: 1 ♂, 1 ?, 11, 19 September 1927; 1 ♂, 12 February; 1 ♀, 9 August 1928.

Arremon aurantiirostris ranges from southern Mexico to northern Peru and, as is to be expected, resolves itself into a number of geographic races; at least six having been named. The most northerly one, *saturatus* of Cherrie, has not been currently recognized, being synonymized with *rufidorsalis* by Carriker (Ann. Carn. Mus., **6**, 1910, p. 902) and both were regarded as synonyms of aurantiirostris by Ridgway (Birds No. and Mid. Amer., pt. 1, 1901, p. 457). Todd (Proc. Biol. Soc. Wash., **35**, 1922, p. 90) described *Arremon aurantiirostris strictocollaris* from Rio Atrato, Colombia, a form that is now known to range from Darien into northern Colombia.

It is not my intention to make out a case for *saturatus;* with plenty of material, the form can probably be upheld, so I leave that to my colleague, Mr. Griscom, who is now working up the magnificent Dwight Collection of Guatemalan birds for the American Museum. What I wish to point out is that *rufidorsalis* is a perfectly good subspecies. Compared with *a. aurantiirostris, rufidorsalis* is characterized by having a somewhat broader superorbital stripe more prolonged anteriorly. This stripe in *rufidorsalis* is white throughout its entire length, whereas in *a. aurantiirostris* the part lying behind the eye is invaded with gray. *A. a. rufidorsalis* ranges over Costa Rica except in the southwestern part of the country, and extends down the Caribbean slope of western Panama into the Chiriqui Lagoon region. Just where it merges on the north with *saturatus* (provided that form is recognizable) has not been determined. *A. a. aurantiirostris* inhabits southwestern Costa Rica and the Pacific slope of Panama south at least to the Canal Zone.

COEREBIDAE

Coereba mexicana mexicana (Sclater)

Additional specimens.— Changuinola: 2 ♂, 4, 9 October 1929. Almirante: 1 ?, 1 juv. ♂, 13, 26 May; 1 ♂, 8 June 1927; 2 ♂, 16 March, 18 July 1928. Western River: 1 ♀, 27 June 1928. Shepherd Island: 1 ♂, 17 May 1928. Gerchow Key: 1 ♂, 1 ♀, 5 July 1928.

Dacnis cayana ultramarina Lawrence

Almirante: 1 ♀, 5 May; 1 ♂, 1 ♀, 14 July 1927; 11 ♂, 2 ♀, 21 June to 15 November 1928.

Cyanerpes lucidus isthmicus Bangs

Additional specimens.— Almirante: 4 ♂, 4 ♀, 21 June to 2 July 1928.

Chlorophanes spiza arguta Bangs and Barbour

Additional specimens.— Changuinola: 1 ♂, 9 December 1928. Almirante: 2 ♂, 15 November 1928. Boquete trail: 5 ♂, 2 ♀, 11–27 March 1928.

THRAUPIDAE

Tanagra luteicapilla (Cabanis)

Additional specimens.— Changuinola: 1 ♂, 9 December 1927. Almirante: 2 ♂, 1 ♀, 1 ?, 10 November to 29 December 1928.

Tanagra gouldi praetermissa Peters

Additional specimens.— Changuinola: 1 ♂, 1 ♀, 29, 30 September 1929. Almirante: 1 ♂, 3 May 1927; 1 ?, 13 July 1928. Guabo: 3 ♂, 2 ♀, 3–9 April 1928. Cricamola: 1 ♂, 14 August, 1927; 1 ♂, 1 ♀, 11, 15 February; 1 ♂, 1 ♀, 14 August 1928.

Tanagra olivacea humilis (Cabanis)

Almirante: 2 ♂, 15 November, 29 December 1928.

Tangara guttata eusticta Todd

Additional specimen.— Boquete trail: 1 ♂, 25 March 1928.

Tangara larvata franciscae (Sclater)

Additional specimens.— Changuinola: 1 ♂, 13 June; 1 ♀, 30 September; 1 ♀, 30 November 1928. Almirante: 1 ♀, 15 April; 1 ♂, 1 ♀, 16 May; 3 ♂, 1 ♀, 28 July to 29 August 1927; 1 ♀, 21 June 1928. Zegla: 1 ?, 1 ♀, 16–31 December 1927; 2 ♂, 16 November 1928. Cricamola: 1 ♂, 14 August 1929.

In our report on the birds of the Almirante Bay region, Mr. Kennard and I overlooked the fact that *Calliste franciscae* "Lafr." (Sclater, Proc. Zoöl. Soc. London, 1856, p. 142, Rio David, Chiriqui) is an earlier name for this form than *centralis* Berlepsch. Sclater believed his bird from Chiriqui to be the same as *Aglaia fanny* Lafresnaye of northwestern South America, but pointed out the characters by which the bird from western Panama differed from typical *larvata* of northern Central America and southern Mexico. He no doubt imagined that he was merely emending *fanny,* but under the present rules of

nomenclature *franciscae* is a different name from *fanny*, and being earlier than *centralis* and applying to the same bird, must replace it.

This seems to be an opportune place for pointing out what may happen as a result of the temptation to "emend" or otherwise tinker with another author's names.

Tangara lavinia dalmasi Hellmayr

Boquete trail: 1 ♀, 20 March 1929.

Thraupis cana diaconus (Lesson)

Additional specimens.— Changuinola: 1 ?, 28 December 1926; 1 ♀, 27 September 1927. Almirante: 2 ♂, 1 ♀, 7–27 May; 1 ♀, 8 June; 1 ♂, 29 August 1927. Isla Grande: 1 ♂, 18 July 1927. Cricamola: 1 ♀, 17 February 1928.

Thraupis palmarum atripennis Todd

Almirante: 1 ♂, 16 May 1928. Chiriquicito: 1 ♂, 1 imm. ♂, 16 April 1928.

Ramphocelus passerinii Bonaparte

Additional specimens.— Almirante: 12 ad. ♂, 4 imm. ♂, 5 ♀, 19 April 1927 to 18 November 1928. Banana River: 1 ♀, 17 July 1928. Chiriquicito: 2 ♂, 16, 17 April 1928. Cricamola: 1 ♂, 27 September 1927.

Ramphocelus icteronotus Bonaparte

Cricamola: 2 ad. ♂, 1 imm. ♂, 14, 18 August, 12 September, 1927; 2 ♂, 1 ?, 20–26 August 1928.

These specimens mark the western limit of the range of the species on the Caribbean slope of Panama. It has been recorded from Santiago de Veraguas on the basis of birds collected by Arcé. It was also taken on the Rio Calovevora by Benson in 1926 (Griscom ms.).

Phlogothraupis sanguinolenta aprica Bangs

Almirante: 1 ♂, 8 November 1928.

Piranga rubra rubra (Linné)

Additional specimens.— Changuinola: 1 ♂, 27 January 1929. Almirante: 1 ♂, 1 ♀, 22 November, 7 December 1928. Boquete trail: 1 ?, 20 March 1928.

Piranga flava testacea Salvin and Godman

Boquete trail: 2 ♂, 26 March 1928.

Chlorothraupis carmioli carmioli (Lawrence)

Additional specimens.— Boquete trail (1,300–1,800 feet): 1 ♂, 1 ♀, 19–25 March 1929.

The specimens from the Almirante Bay region show an approach to *C. c. magnirostris* Griscom in having a slightly heavier bill, with the upper mandible a trifle swollen basally; otherwise they do not differ from a large series of typical *carmioli*, to which I believe they should be referred.

Habia fuscicauda Cabanis

Changuinola: 1 ♂, 3 October 1927; 1 ♂, 29 September; 1 ♂, 31 December 1928. Almirante: 6 ♂, 1 ♀, 3–25 May; 1 ♂, 1 ♀, 10, 15 June 1927; 1 ♂, 19 January; 1 ♀, 7 May; 1 ♂, 21 June; 1 ♀, 26 July; 1 ♂, 17 September 1928. Western River: 1 ♂, 12 May 1928. Cricamola: 1 ♀, 11 August 1928.

Lanio leucothorax ictus Kennard and Peters

Additional specimens.— Boquete trail (1,500–2,000 feet): 2 ♂, 1 ♀, 17–25 March 1928.

The range of this intermediate form remains to be determined. So far it is known from five specimens, all secured on the Boquete trail, between 1,500 and 2,300 feet.

Heterospingus rubrifrons (Lawrence)

Western River: 1 ♂, 12 July 1928.

Tachyphonus rufus (Boddaert)

Changuinola: 1 ?, 25 January 1929. Almirante: 1 ♂, 1 ♀, 6, 16 May, 1927; 1 ♂, 3 May; 1 ♂, 14 June; 2 ♀, 15, 27 November 1928. Chiriquicito: 1 ♂, 14 June 1927.

Tachyphonus axillaris (Lawrence)

Additional specimens.— Changuinola: 1 ?, 25 January 1929. Boquete trail: 3 ♂, 16–26 March 1928.

Tachyphonus delatrii Lafresnaye

Additional specimens.— Boquete trail: 5 ♂, 11–19 March 1928. Cricamola: 1 ♀, 19 August 1928.

Chrysothlypis chrysomelas chrysomelas (Sclater and Salvin)

Additional specimens.— Boquete trail: 5 ♂, 2 ?, 11–27 March 1928.

Mitrospingus cassinii costaricensis Todd

Boquete trail (3,500 feet): 1 ♂, 29 March 1928. Guabo: 3 ♂, 2, 12 April 1928.

This subspecies is just about recognizable; the characters separating it from *M. c. cassinii* being best appreciated when series are viewed. The specimens here listed are the first to be recorded from Panama.

Mitrospingus cassinii cassinii (Lawrence)

Cricamola: 1 ♂, 28 August 1928.

This bird agrees better with examples of the typical form from the Canal Zone than with birds from eastern Costa Rica and the four listed above.

ICTERIDAE

Zarhynchus wagleri wagleri (Gray)

Additional specimens.— Almirante: 1 ?, 21 August; 1 ♀, 23 December 1926.

Gymnostinops montezuma (Lesson)

Additional specimen.— Sixaola: 1 ♂, 15 January 1927.

Cacicus microrhynchus Sclater and Salvin

Additional specimens.— Changuinola: 1 ♂, 13 June; 1 imm. ♂, 26 September 1928. Almirante: 1 ♂, 30 April; 1 ♂, 1 ♀, 6 May; 1 ♂, 1 ♀, 15, 26 June 1927; 1 ♂, 7 May; 1 ♂, 2 July 1928. Western River: 2 ♂, 1 ♀, 29 June to 12 July 1928. Boquete trail: 3 ♂, 2 ?, 14–28 March 1928. Guabo: 1 ♂, 1 ♀, 3 April 1928. Cricamola: 1 ♂, 20 August 1928.

Amblycercus holosericeus holosericeus (Lichtenstein)

Additional specimens.— Almirante: 1 ♀, 19 April; 1 ♂, 17 May; 1 ♂, 8 June; 1 ?, 30 July 1927; 1 ♂, 1 ♀, 10, 20 June, 1928; 1 ?, 18 January 1929. Cricamola: 1 ?, 8 August 1928.

Psomocolax oryzivorus impacifus Peters

Additional specimens.— Almirante: 2 ♂, 10 May, 7 December 1928.

Kennard and I originally recorded the rice grackles from about Almirante as *violeus*, but I am now convinced that they are best referred to *impacifus*. They are not quite typical of that form in that there are traces of a bronzy wash present on two of the three males, but in other respects are much nearer to *impacifus*.

Icterus galbula (Linné)

Additional specimens.— Sixaola: 1 ♂, 15 January; 1 ♂, 16 November 1927 Changuinola: 1 ♂, 31 January; 1 ♀, 30 September 1928. Almirante: 1 ♂, 1 ♀ 1 ?, 4 October, 9, 16 November 1928; 1 ♂, 18 January 1929.

Icterus spurius (Linné)

Additional specimen.— Cricamola: 1 ♂, 16 February 1928.

Icterus prosthemelas (Strickland)

Additional specimens.—Changuinola: 1 ♀, 19 May 1927; 1 ♂, 30 September 1928. Almirante: 1 ♂, 19 April 1927. Western River: 1 ♂, 12 July 1928. Chiriquicito: 1 ♀, 16 April 1928.

Icterus mesomelas salvini Cassin

Additional specimens.— Changuinola: 2 ♂, 14 July 1928. Almirante: 1 ♂, 25 May 1926; 1 ♂, 19 February; 1 ♂, 25 May; 1 ♂, 14 June 1927; 1 ♀, 20 June; 1 ♂, 12 November 1928. Western River: 1 ♂, 27 June 1928. Guabo: 1 ♀, 10 April 1928.

CORVIDAE

Cyanocorax affinis zeledoni Ridgway

Additional specimens.— Changuinola: 1 ♀, 23 September 1928. Guabo: 2 ♂, 1 ♀, 2–13 April 1928. Boquete trail: 1 ♀, 1 April 1928. Cricamola: 1 ♀, 1 ?, 14, 20 August; 5 ♂, 1 ♀, 1 ?, 9–11 September 1927; 2 ♂, 2 ♀, 10–16 February; 1 ♂, 3 ♀, 2 ?, 5–11 August 1928.

Psilorhinus mexicanus captus Kennard and Peters

Additional specimens.— Guabo: 1 ♂, 1 ♀, 1 ?, 7–15 April 1928. Chiriquicito: 1 ♂, 17 April 1928. Cricamola: 1 ♂, 27 August; 4 ♂, 9 September 1927; 1 ♂, 2 ♀, 17 February; 4 ♂, 1 ♀, 13–22 August 1928.

Total number of species collected by Wedel is 272, 17 more included in this report were met with only by Benson, while the following 18 species were collected only by Kennard and Smith:

Chamaepetes unicolor Salvin
Columba leucocephala Linné (also taken by Benson)
Leucopternis princeps Sclater
Elanoides forficatus yetapa Vieillot

Chaetura cinereiventris phaeopygos Hellmayr
Monasa grandior Sclater and Salvin
Thripadectes rufobrunnea (Lawrence)
Dendrocincla meruloides ridgwayi Oberholser
Myiozetetes similis columbianus Cabanis and Heine
Empidonax albigularis australis Miller and Griscom
Empidonax traillii traillii (Audubon)
Empidonax difficilis flavescens Lawrence
Tolmomyias flavotectus (Hartert)
Stelgidopteryx ruficollis serripennis (Audubon)
Turdus plebejus Cabanis
Sporophila corvina (Sclater)
Tangara gyroloides bangsi (Hellmayr)
Cyanolyca cucullata (Ridgway)

Sometime after this paper went to press, Dr. Chapman published a note in the Auk (**48**, Jan. 1931, p. 119–121) listing 31 species of North American migrants (by their vernacular names only!!), collected by R. R. Benson at Cocoplum, Bocas del Toro, between 24 October and 12 November 1927. I have not been able to place Cocoplum on any map available, and time does not permit of inquiry, but inasmuch as the Almirante Bay region and the Panamanian province of Bocas del Toro are practically synonymous, I do not hesitate to include the following nine species given by Chapman, which appear to be new to the region.

Coccyzus americanus americanus (Linné)
Hylocichla minima aliciae (Baird)
Vireo philadelphica (Cassin)
Vermivora chrysoptera (Linné)
Vermivora peregrina (Wilson)
Dendroica coronata (Linné)
Dendroica magnolia (Wilson)
Dendroica castanea (Wilson)
Passerina cyanea (Linné)

Making a total of 316 species now recorded from the Almirante Bay and Chiriqui Lagoon region of Panama.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE.

Vol. LXXI. No. 6

NOTES ON THE BIRDS OF RIO FRIO (NEAR SANTA MARTA), MAGDALENA, COLOMBIA

By P. J. Darlington, Jr.

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM.

March, 1931

No. 6.— *Notes on the Birds of Rio Frio (near Santa Marta), Magdalena, Colombia*

By P. J. Darlington, Jr.

During the fourteen months from February, 1928, to April, 1929, I was employed as entomologist in the Colombia Division of the United Fruit Company. Although the chief task in hand was the study of banana insects, holidays and late afternoons were available for recreation. The first claim on my spare time was made by the private collecting of beetles, but after a few months an occasional hour and, more important in the tropics, a little extra energy were found for ornithological work. This was begun in June, when other work had more or less settled into a routine, and was continued, with a few interruptions, until the following April.

It is unnecessary to include here a detailed description of the country, for a complete account with maps and photographs is being prepared and will probably be published in another bulletin of the Museum of Comparative Zoölogy. Briefly, then, my headquarters were at Rio Frio, a small town lying near the middle of a large triangle of flat coastal plain. The apex of the triangle, to the north, is in a semi-arid region at the port of Santa Marta, while the base, to the south, is in humid country near Aracataca and the Fundacion River. The triangle is about fifty miles long. It is bounded on the west by the Caribbean coast and by a large, swampy, saline lake called the Cienaga Grande, and on the east by the Sierra Nevada de Santa Marta. Rio Frio is located in the intermediate country between the northern dry and the southern humid areas, and is, therefore, favorably situated for a study of the birds of both. A good trail leads from the town into the mountains. Large fresh swamps are accessible near Cienaga, and smaller swamps and rivers are numerous. The important details of the plain are shown on the map on page 351. This entire area is a part of the "Santa Marta region" as defined by Todd and Carriker,[1] who give a detailed account of the region as a whole, although their description of the coastal plain is short.

Since there were many different types of habitat near Rio Frio, each with its quota of characteristic and, to me, unknown birds, I began

[1] The Birds of the Santa Marta Region of Colombia: A Study in Altitudinal Distribution. By W. E. Clyde Todd and M. A. Carriker, Jr. Annals of the Carnegie Museum, **14**, 1922.

by trying to make a census of the species. This involved collecting, for there is no book from which one may hope to recognize the majority of the local birds in the field. Many hours were spent, therefore, in stalking unknown birds with a double-barreled "41" shotgun, trying to learn their characteristics, and then collecting them. It would have been impossible to accomplish anything even in this way, if we had not had a good ice box, by the use of which the skinning of an afternoon's bag could be spread out over two or three evenings. After the first few months the number of birds which it was necessary to shoot decreased steadily, while field notes increased in proportion. Most of the work was confined to the coastal plain, but several visits were paid to the lower hills and two short expeditions were made into the high mountains, although birds were not the primary object at these times. Notes on the few mountain species which were recognized are presented in the proper place.

The total collection numbers 306 skins and includes 237 species. A few other species were shot and identified but for one reason or another (any collector in the tropics will recall many) could not be preserved. The waste of birds was the most objectionable feature of collecting, but the conditions under which the work was done made it sometimes unavoidable. The skins were all shipped to the Museum of Comparative Zoölogy at Cambridge, Massachusetts, where Mr. Outram Bangs has determined most of the species. Some others have been identified by Mr. J. L. Peters, and a few have been compared by myself, usually with Mr. Peters checking my conclusions. The majority of the skins, including all the important records, have been permanently deposited in the Museum of Comparative Zoölogy, the rest

Explanation of

Map of the Coastal Plain West of the Sierra Nevada de Santa Marta, Colombia.*

○ Cities and towns

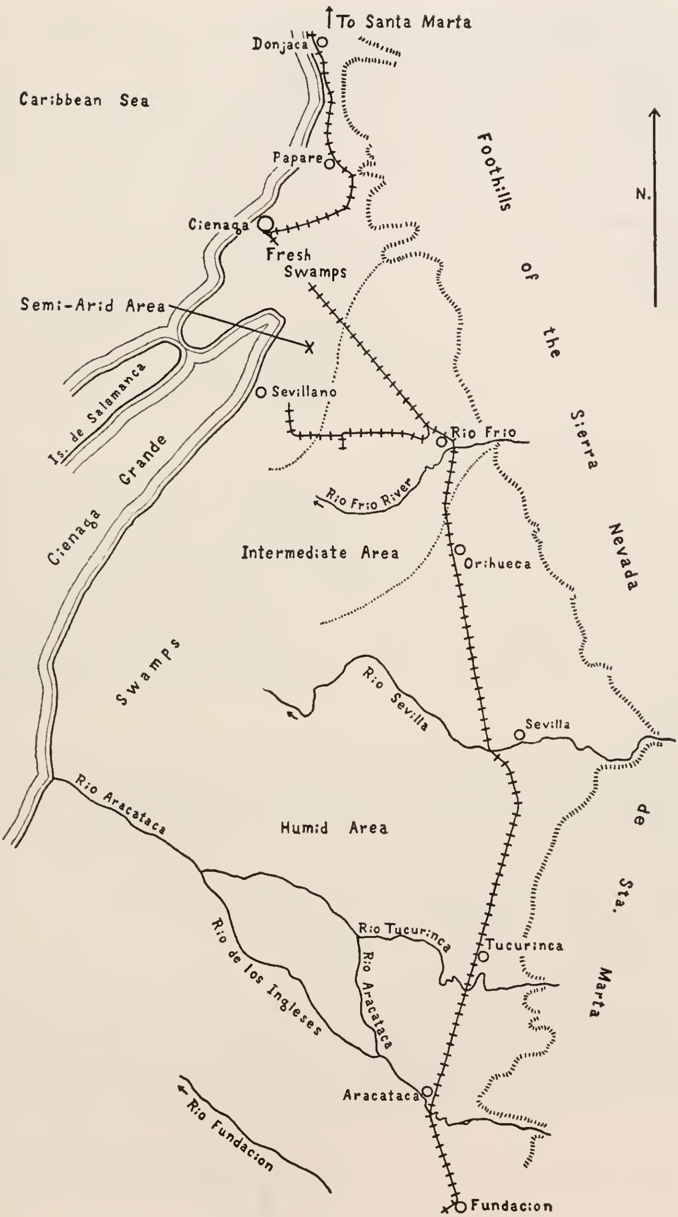
Boundary of the foothills of the Sierra Nevada

Approximate boundaries of the "Areas"

Santa Marta Railroad, with all spurs, except one (the Ramal Toblazo, west of Rio Frio), omitted

Scale about 1 — 400,000; about 6.3 miles to the inch

* I am deeply indebted to the United Fruit Company for permission to base this map on surveys in the Company's possession


To Santa Marta
Donjaca
Caribbean Sea
Papare
Cienaga
Fresh
Swamps
Foothills of the Sierra Nevada de Sta. Marta
N.
Semi-Arid Area
Is. de Salamanca
Sevillano
Rio Frio
Cienaga Grande
Rio Frio River
Intermediate Area
Orihueca
Swamps
Rio Sevilla
Sevilla
Rio Aracataca
Humid Area
Rio Tucurinca
Tucurinca
Rio de los Ingleses
Rio Aracataca
Aracataca
Rio Fundacion
Fundacion

are in the Museum of Zoölogy at the University of Michigan, where my friend, Dr. Josselyn Van Tyne, is Assistant Curator of Birds.

The fine volume by Todd and Carriker, already cited, on the Birds of the Santa Marta Region must be the basis for any further studies on the subject, so that it might at first seem unnecessary to publish more than supplementary notes. I have decided to do so, however, for two reasons. The first is because no collections of any size have been made before near Rio Frio, or, indeed, in any part of the interesting intermediate area between the dry and humid parts of the coastal plain, so that this area, while included by Todd and Carriker, is really but little known. The second is because my observations were made in one place for the greater part of a year so that, taken as a whole, they give a more nearly complete picture of the avifauna of a strictly limited tropical locality than is usually obtained or than Todd and Carriker attempt to give.

Acknowledgments are due primarily to Mr. Outram Bangs and Mr. J. L. Peters, ornithologists at the Museum of Comparative Zoölogy, for the identification of material as described above. Mr. Bangs was the first ornithologist to work extensively on the Santa Marta birds, and he has used his wide knowledge of the subject liberally in my behalf. It is impossible to acknowledge in detail the courtesies received from various friends in Colombia, but I must mention the securing of several desirable specimens by Mr. Cornelius Opryshek. I am indebted to Dr. Josselyn Van Tyne for valuable suggestions on many parts of the paper.

It is proper to preface the annotated list of species with a certain amount of general discussion. First, it will be convenient to tabulate the additions which are made to Todd and Carriker's previously mentioned list of birds of the Santa Marta region. The species of *Casmerodias, Chauna,* and *Cairina* are included on field identifications as described under their respective headings; the other records are based on specimens. *Dumetella carolinensis* (Linné), the Catbird, and *Dendroica c. coronata* (Linné), the Myrtle Warbler, seem to be previously unrecorded from South America, while *Porzana flaviventer bangsi* is described as new. This list closes very few of the local *lacunae* which are discussed by Todd and Carriker, and so does not affect their statement that the Santa Marta fauna is depauperate.

Additions to the List of Birds of the Santa Marta Region

(List 1)

Poliocephalus dominicus brachyrhynchus (Chapman)
Ixobrychus involucris (Vieillot)
Casmerodias alba egretta (Gmelin)
Chauna chavaria (Linné)
Cairina moschata (Linné)
Querquedula d. discors (Linné)
Porzana flaviventer bangsi Darlington
Porzana albicollis (Vieillot)
Gallinula chloropus pauxilla Bangs
Catoptrophorus semipalmatus inornatus (Brewster)
Arenaria interpres morinella (Linné)
Claravis m. mondetoura (Bonaparte)
Coccyzus pumilus Strickland
Podager nacunda minor Cory
Chordeiles minor aserriensis Cherrie
Lurocalis s. semitorquatus (Gmelin)
Chaetura andrei meridionalis Hellmayr
Dumetella carolinensis (Linné)
Phaeoprogne t. tapera (Linné)
Dendroica c. coronata (Linné)
Sporophila lineola restricta Todd

Thirty-seven migrant or non-resident species were secured by the writer and are listed below. The six which are starred are additions to the list of sixty-six given by Todd and Carriker (pp. 56, 57), so that the total number of known non-resident species in the Santa Marta region is now seventy-two.

List of Migrants Recorded in this Paper

(List 2)

*Querquedula d. discors
Porzana carolina
Bartramia longicauda
Actitis macularia
Tringa s. solitaria
Totanus flavipes
*Catoptrophorus semipalmatus inornatus
Capella gallinago delicata

Charadrius semipalmatus
*Arenaria interpres morinella
Coccyzus a. americanus
*Chordeiles minor aserriensis
Tyrannus c. curvirostris
Tyrannus tyrannus
Myiarchus c. crinitus
Empidonax t. traillii
*Dumetella carolinensis
Hylocichla minima aliciae ?
Vireo f. flavoviridis
Hirundo rustica erythrogaster
Setophaga ruticilla
Seiurus n. noveboracensis
Seiurus motacilla
Oporornis philadelphia
Oporornis agilis ?
Oporornis formosus
Dendroica striata
Dendroica a. aestiva
*Dendroica c. coronata
Vermivora peregrina
Protonotaria citrea
Mniotilta varia
Icterus galbula
Icterus spurius
Piranga r. rubra
Hedymeles ludovicianus
Spiza americana

Before discussing the distribution of birds near Rio Frio, it will be necessary to list several groups of the commoner and more conspicuous species, that is to say, the species of which the local ranges have been determined with some accuracy. All non-resident species have been omitted, as have all those with aquatic or semi-aquatic habits.

Commoner Birds Locally Restricted to the Semi-arid Area

(List 3)

Scardafella squammata ridgwayi
Columba gymnophthalmos
Sapphironia caeruleigularis duchassaingi

Podager nacunda minor
Mimus gilvus columbianus
Cassidix mexicanus assimilis

Commoner Birds Characteristic of, but not Restricted to, the Semi-arid Area

(List 4)

Columbigallina passerina albivitta
Aratinga pertinax aeruginosa
Crotophaga major
Muscivora tyrannus
Machetornis rixosa flavigularis
Heleodytes pardus
Sicalis f. flaveola

Commoner Birds Generally Distributed on the Coastal Plain

(List 5)

The species of the following list vary in their center of abundance, some being more abundant in the semi-arid, others in the humid areas, while still others are evenly distributed. All are fairly common in suitable habitats throughout the plain, however.

Coragyps urubu
Gampsonyx swainsoni meridensis
Falco sparverius isabellinus
Polyborus c. cheriway
Colinus sonninii decoratus
Leptotila v. verreauxi
Columbigallina r. rufipennis
Columba rufina pallidicrissa
Forpus spengeli
Brotogeris j. jugularis
Hypnelus r. ruficollis
Galbula ruficauda pallens
Picumnus c. cinnamomeus
Chrysoptilus punctigula ujhelyii
Centurus r. rubricapillus
Dendroplex p. picirostris
Sakesphorus canadensis pulchellus
Furnarius leucopus longirostris

Tyrannus melancholicus chloronotus
Troglodytes musculus atopus
Heleodytes minor albicilius
Icterus n. nigrogularis
Molothrus bonariensis cabanisi

It would be possible to draw up a list of the birds inhabiting both the humid and intermediate areas but not occurring in the semi-arid one, but such a list would be of no value here. It would contain the majority of the commoner species not included in the preceding lists, for all of the humid-country birds except a few strict forest dwellers occur in the so-called intermediate area. The intermediate area is, therefore, less well defined than the others. It consists mostly of the depauperate outskirts of the humid area, and seems to have no characteristic species of its own. Its recognition, however, brings out certain points which would otherwise be obscured.

In discussing the local ranges of birds it will be necessary to distinguish clearly just what is meant here by "area" (semi-arid, intermediate, and humid) and what relation the areas bear to habitat. The three areas have already been mentioned and are outlined on the map on page 351. They are each continuous, and are characterized by different degrees of humidity and by different types of vegetation, but they must not be thought of as homogeneous, for each contains many different sorts of country which may be referred to as habitats. Thus there are, among others, forest, second-growth, semi-open, and field habitats in the humid area, and a similar range of dry forest, second-growth, semi-open, and field habitats in the intermediate area, although as a rule the corresponding habitats of the two areas are distinctly different. One can also speak of a woodland habitat in general, meaning the various sorts of forest and second-growth of the humid and intermediate areas combined. "Woodland" is merely one example of a class of words which are easily understood and which are particularly useful in indicating the general habitat of a bird when the exact boundaries of its range are not known. Such general terms are made necessary by the complex intergradation of many of the local habitats. The matter is still further complicated by the fact that, although there are many birds which may be assigned to such general habitats as "woodland" or "semi-open" (the latter is a particularly useful word), there seem to be comparatively few common ones with mutually coinciding local ranges.

The first outstanding characteristic of the local avifauna is the great

preponderance of both species and individuals in the humid area. The small number of species in the semi-arid area is shown in the lists, while the comparative paucity of individuals is soon noticed in the field. This is closely correlated with the distribution of vegetation, for the semi-arid plain supports only a low scrub which is not comparable to humid forest or even to the heavier growths of deciduous "dry forest." Furthermore, the small size of the local semi-arid area, its isolation from other tracts of similar country, and the small variety of habitat which it offers are all factors which tend to reduce the number of species found there. The distribution of the birds is probably not directly dependent on humidity, but rather on the plants which yield food. Precipitation and humidity are largely instrumental in determining the nature of the flora, however, so the final effect is the same. As an entomologist, I noticed particularly that insects were scarce in the semi-arid region. This fact also is correlated with the distribution of plants and contributes directly to the scarcity of the birds.

Another striking fact is that most of the birds are distributed by habitat rather than by "area." Thus the more open habitats of the humid area have, as far as the birds go, more in common with the open parts of the distant semi-arid area than they have with the adjacent humid forest. This is, of course, another example of the dependence of birds on the flora rather than on humidity. It may be added that birds often ignore what seem to us to be distinct natural boundaries. This is illustrated by the fact that only two of the commoner species (*Basileuterus delattrii mesochrysus* and *Arremon schlegeli*) were found to have their local ranges exactly limited by the edge of the Rio Frio hills. Both of these birds inhabited the foothill valleys of the Sierra Nevada and descended down to, but not upon, the plains.

List number 5 (of birds occurring in all three areas) illustrates another local phenomenon, that successful or dominant species, those which are represented by many individuals in any given locality, are, on the whole, more generally distributed than the others. Of the thirty-three species on the list, all but seven (*Gampsonyx swainsoni meridensis, Falco sparverius isabellinus, Forpus spengeli, Picumnus c. cinnamomeus, Chrysoptilus punctigula ujhelyii, Sakesphorus canadensis pulchellus,* and *Molothrus bonariensis cabanisi*) are conspicuously successful as judged by the number of individuals encountered in the field. No such average abundance was noted among the birds which are confined to one or two of the local areas. It will be noticed that almost all of the birds which are conspicuously dominant and generally distributed

on the coastal plain are species inhabiting semi-open land. Since the semi-open is mostly of recent origin (produced by man in the last century or two), many of its birds must be new arrivals which owe their presence to their vigor and ability to invade new country. It is possible, therefore, that there would be a much weaker correlation between dominance and general distribution if the vegetation of the coastal plain had not been modified so recently. Among the beetles, too, as among the birds, the species which inhabit the semi-open are usually more dominant, *i. e.* are represented by much larger or denser populations, than are those which inhabit the forest.

It may be noted in passing that it is true of this region, as of others, that the birds which are popularly thought of as "tropical" are, usually, forest dwellers. They include most of the curassows, macaws, large parrots, toucans, trogons, woodhewers, and manakins.

The true water birds and such land birds as are closely associated with swamps (especially the hawks *Rostrhamus sociabilis* and *Busarellus nigricollis*, the ovenbird *Certhiaxis cinnamomeus fuscifrons*, the flycatchers *Arundinicola leucocephala* and *Fluvicola pica*, the mockingbird *Donacobius atricapillus brachypterus*, and the yellow-headed blackbird *Agelaius i. icterocephalus*) are distributed without reference to the "areas." The largest fresh swamps are at Cienaga, for instance, and are entirely surrounded by semi-arid country, but they swarm with herons, gallinules, jacanas, and a host of less conspicuous birds. The most attractive parts of the Cienaga swamp are the cat-tail (*Typha*) beds. Unlike most *Typha* swamps, they usually have hard bottoms, so that one can wade easily and very quietly through parts of them by following certain narrow, natural paths through from two to five feet of water. The ornithologist has thus the unique experience of being able to stalk and observe rails in their normal haunts. Fortunately the swamps are so near the city of Cienaga that there is no danger of really large crocodiles, although small ones abound. The mangrove swamps of the Cienaga Grande are also worth mentioning, but I had so little opportunity to visit them that I can add nothing to the account given by Todd and Carriker (p. 67).

Perhaps the most interesting local birds are those (list 4) which regularly inhabit the semi-arid area but which are sometimes found in the more humid regions, for they include several species which seem to have a distinct seasonal migration. This consists of a movement of *part* of the population from the semi-arid to the intermediate or humid areas during the dry season (December to May). The cause is probably seasonal variation in the food supply in the drier areas, which have

more contrasted seasons than the wet ones, just as the migration of our northern birds is due to seasonal variation in the food supply in the North. The species definitely involved are *Columbigallina passerina albivitta, Aratinga pertinax aeruginosa, Crotophaga major,* and *Sicalis flaveola flaveola.* These are all common and conspicuous birds, and their presence at Rio Frio during the dry season and not at other times was well established as described for each species under its specific heading in the annotated list. The same migratory habits may have been overlooked in other less conspicuous birds.

It is not to be understood that the birds which are local migrants at Rio Frio are not resident in other parts of the more humid plain, for the *Columbigallina, Crotophaga,* and *Sicalis* were all found by Carriker at Tucurinca or Fundacion during the rains. One must remember, also, that none of the species entirely deserts the semi-arid area at any time. The *Aratinga* is the simplest case, for it seems merely to extend its range a little when dry weather sets in and to contract it a little on the return of the rains. It does not require much imagination to suppose that the three other species once had the same habit, but that part of their population has been permanently stranded in the humid area. It is possible, of course, that the opposite process has occurred and that one or more of the species has invaded the dry from the humid area by migration at favorable seasons. In any case, the result seems to be that each species has two breeding ranges located in different types of country, and separated by a space which is utilized as a feeding ground only at certain times, when the birds are pressed for food.

The isolation of part of a species in a habitat different from that of the parent stock is a condition which is supposed to favor the formation of a local race. It has apparently not been effective in the species discussed above, but it may have been in the case of *Forpus spengeli.* This little parrot is common both in the semi-arid scrub at Cienaga and in the open woodland at Aracataca, but is much less frequently encountered in the intermediate area near Rio Frio. It has thus two local centers of abundance, although they seem to be connected by a scattering of resident birds (this may not be the case, for parrots range more widely than most other birds, so that wandering flocks from the dry area may have reached Rio Frio at all seasons). *Forpus spengeli* seems already to have started differentiating, for Todd and Carriker (p. 203) point out differences between Cienaga and Fundacion birds.

That local migration, caused by variation in the food supply of one of two adjacent tropical environments, has resulted in the isolation and modification of part of a species is an hypothesis which requires

more study for its confirmation. In any case, the division of a comparatively homogeneous habitat into two or more parts by geological changes seems to have been a more effective agent locally. This is clearly shown by Todd and Carriker's discussion of the relationships of the birds of the Santa Marta Mountains. The local subtropical and temperate zones, for instance, have no birds represented by a race in each (except possibly one species of *Henicorhina*), while several species of each have allied races in the corresponding zones of the Andes. It seems that, in these cases at least, isolation has been more important in the formation of local races than have differences in climate.

Several other subjects, such as the songs of neotropical birds and the distribution of bird life in a tropical forest, are so excellently treated in Chapman's recent book [1] on Barro Colorado Island that there would be no excuse for discussing them here. There remain to be considered, therefore, only a few minor details concerning the annotated list.

As far as possible, the present paper follows the order and terminology of The Birds of the Santa Marta Region. When it has been necessary to use a different name or combination of names for a species, the one used by Todd and Carriker is cited in synonymy; otherwise all synonyms are omitted. Only such native names as seem to be in common use have been mentioned, for many obliging Colombians will coin names while the ornithologist waits. I have tried to spell the names just as I heard them. This means that some will differ from the spelling of previous writers, and that very few will be found in a dictionary of pure Castilian Spanish.

The relative abundance of each species has been indicated by such terms as "common," "scarce," and "rare." When a bird was recorded only once or twice, however, the actual records have been given, but, since all dates lie between June, 1928 and April, 1929, the year has usually been omitted. Each bird's habitat is indicated as far as possible, and notes on taxonomic relationship, nesting, songs, and behavior have often been added. All the species which were recognized in Colombia have been included, but consecutive numbers have been given only to those which were found within three miles of Rio Frio, so that the strictly local Rio Frio fauna may be distinguished at a glance. Unless a definite statement is made to the contrary, every numbered species has been identified from a specimen collected near the town, although exact records of many of the commoner ones have been omitted. Descriptions have been almost entirely omitted, except that brief notes

[1] My Tropical Air Castle, by Frank M. Chapman, Appleton, 1929.

have been added to aid in the recognition of a few of the commoner local species which are not included in Sturgis' Field Book of the Birds of the Panama Canal Zone.[1]

Annotated List of Species

Family COLYMBIDAE. Grebes

Poliocephalus dominicus brachyrhynchus (Chapman)

Two of these little grebes were encountered on March 9 in a weedy bay of one of the larger open ponds in the Cienaga fresh swamps. Neither bird showed more than its head above the water at any time. One of them, an adult ♀, was collected and apparently constitutes the first record for the species from the Santa Marta region, although its occurrence there is not surprising. On April 13, about fifteen birds were seen in the same pond. They spent comparatively little time submerged but took short flights of forty or fifty feet when approached too closely.

Family PHALACROCORACIDAE. Cormorants

1. Phalacrocorax olivaceus olivaceus (Humboldt)[2]

Phalacrocorax vigua vigua Todd and Carriker.

Cormorants are common along the Cienaga Grande at Sevillano and in the Cienaga fresh swamps. Near Rio Frio they occur along the river, which they follow for at least a kilometer into the foothills of the Sierra Nevada. No specimens were taken.

Family PELECANIDAE. Pelicans

Pelecanus occidentalis Linné

The Brown Pelican is never seen inland even along the rivers, but is a common and conspicuous bird on the coast and in the Cienaga Grande near Sevillano.

Family ARDEIDAE. Herons

Ixobrychus involucris (Vieillot)

The dense mass of cat-tails (*Typha*) which occupies many acres of the Cienaga fresh swamp forms ideal cover for such a retiring bird as this

[1] Field Book of Birds of the Panama Canal Zone, by Bertha B. Sturgis, Putnam's, 1928.
[2] *Cf.* Richmond, Proc. Biol. Soc. Washington, **39**, 1926, p. 142.

little, streaked bittern, which was, indeed, seen nowhere else. It is probably fairly common, for three birds were shot and several others flushed, but it is very difficult to detect in its chosen haunts. The two specimens preserved both appear to be adult males; one was collected November 24 and the other April 13.

I. involucris seems not to have been recorded before from anywhere so far north, its known range having included parts of Argentina, Patagonia, Uruguay, South Brazil, and Chile. Of the two Cienaga specimens, Mr. Bangs says, "I have compared these with five birds from Chile and Argentina borrowed from the United States National Museum. The northern birds are quite the same in both size and color."

Casmerodias alba egretta (Gmelin)

A large and shy white heron was seen occasionally in the fresh swamps at Cienaga and was common across an arm of the Cienaga Grande from Sevillano in January. Scores of individuals were standing along the edge of open water, looking, from the distance of a quarter mile or more, like Japanese figures against the dark green of the mangroves. The birds were almost certainly American Egrets. Although the species has not been recorded before from the Santa Marta region, it is mentioned from the Cauca Valley and the Magdalena River by Chapman.

2. Florida caerulea (Linné)

An abundant bird in the fresh marshes of Cienaga. Although no specimens were taken, I am reasonably sure that a small white heron seen on a few occasions near Rio Frio was of this species.

3. Pilherodius pileatus (Boddaert)

This is a pearl-gray and white heron with a black crown and sometimes with a few long, ribbon-like, white occipital plumes. An adult ♀ was collected at Rio Frio on March 7, and other birds were seen from time to time near small swamps or irrigating ditches, often in the open forest. By day they were usually found in the tops of trees.

4. Butorides striatus striatus (Linné)

Butorides striatus Todd and Carriker.

An adult ♂ of *B. striatus* was secured in a fresh marsh near Rio Frio, September 28. My field notes do not distinguish between the two

species of *Butorides* which have been previously recorded from the region. One or both are abundant in the fresh swamps at Cienaga and Rio Frio, and wherever else there are suitable retreats. On several occasions during March and April numbers were observed at dusk on gravel bars of the Rio Frio River just above the railroad, but I did not discover whether they spent the day in the neighboring trees or flew over from the swamps, of which the nearest was about a mile away.

Nycticorax nycticorax naevius (Boddaert)

Several Black-crowned Night Herons were noted in trees in the fresh swamps at Cienaga on March 9.

Family CICONIIDAE. Storks

Mycteria americana (Linné)

Three Wood Ibises were seen together beside a shallow, muddy pool in a pasture near Cienaga, not far from the swamps, on March 22. They flushed at a long distance from my gasoline track car (evidence that they were not familiar with the region) and were not seen again.

Family ANHIMIDAE. Screamers

Chauna chavaria (Linné)

"Chevarias" are said by hunters to be common in the swampy forest along the lower parts of the Aracataca and Tucurinca Rivers. I flushed one from a swamp near Aracataca on March 3 and several times saw a tame individual in the United Fruit Company's *Prado* at Sevilla. This bird would attack and rout dogs with its wing spurs. The local name is derived from the raucous call, which is frequently uttered at night. No specimens were taken, but the bird is, of course, easily recognized by its large size, erect posture, pale head and crest, and large wing spurs. Its addition to the Santa Marta list was to be expected, for Chapman has noted the species as common along the Magdalena River.

Family ANATIDAE. Ducks, etc.

Cairina moschata (Linné)

Local hunters are familiar with a duck which they call the "Pato Real," which is said to occur during the dry season in huge flocks in

isolated swamps along the Cienaga Grande west of Aracataca. It is also occasionally reported elsewhere. The bird is always described as black with a red head and with white on the wings, and was stated by a reliable sportsman to reach a weight of nine pounds. Unfortunately I never saw this duck, but its identification as the Muscovy can hardly be doubted, especially since Chapman has recorded the species from the lower Magdalena River. The bird is new to the Santa Marta list.

Dendrocygna discolor Sclater and Salvin

A flock of about a dozen Tree Ducks was seen repeatedly in the fresh marshes of Cienaga during November. They usually fed in pairs or small groups in small, weedy swamp holes, but gathered in tall trees when flushed. An adult ♂ was collected November 17. The species was entirely absent from this locality during the following February and March.

Querquedula discors discors (Linné)

A solitary ♀ Blue-winged Teal was collected in the Cienaga fresh marshes on November 10 and a ♂ was secured from a flock of five encountered in the same place on March 9. This is probably the duck which was present in thousands on the shallow, open water of the Cienaga Grande near Sevillano during the dry season (noted January 20 and February 20). The birds at this place had learned to avoid the shores, however, and would not fly past an unconcealed hunter, so that none could be obtained. The two Cienaga specimens seem to be the first recorded from the Santa Marta region. The ♂ shows traces of white on the nape and superciliaries but does not attain the characters of *Q. d. albinucha* Kennard, the status of which is still considered doubtful.

Family CATHARTIDAE. American Vultures

5. Sarcoramphus papa (Linné)

6. Cathartes aura aura (Linné)

7. Coragyps urubu (Vieillot)

In the neighborhood of Rio Frio, the Black Vulture is abundant, the Turkey Vulture fairly common, and the King Vulture rather rare. The last species was seen at Sevilla in November and near Rio Frio December 7, December 21 (two individuals), March 10 and March 17. No vultures were collected and no special remarks on any of them are

necessary except to note that I have seen a large tree in second-growth country east of Sevilla where a Black Vulture was said to have nested, the nest having been on the ground between the root buttresses. I mention this unsubstantiated record only because Carriker has commented on the small number of nests which have been found locally.

Family ACCIPITRIDAE. Hawks, in part

8. Chondrohierax uncinatus uncinatus (Temminck)

Only two individuals were seen, both in open forest near Rio Frio. Both were secured, a ♀ on August 19 and an unsexed bird on March 15.

9. Gampsonyx swainsoni meridensis Swann

Gampsonyx swainsoni Todd and Carriker.

Carriker correctly likens the haunts and habits of this pale little kite to those of the Sparrow Hawk (*Falco sparverius isabellinus*). The two species are about equally common near Rio Frio.

10. Harpagus bidentatus bidentatus (Latham)

Harpagus bidentatus Todd and Carriker.

The *Harpagus* resembles a small *Buteo* in the field. It occurs in woodland, and was recorded only twice near Rio Frio, once when an adult ♂ was brought in by my friend Cornelius Opryshek, on December 3, and once when I shot (but failed to preserve) a bird on March 10.

11. Ictinia plumbea (Gmelin)

The only individual seen, an adult ♂, was shot from a tall tree in partly cleared land near Rio Frio, March 11. Its stomach contained the broken remains of a large beetle of the genus *Chalcolepidius*.

12. Rostrhamus sociabilis sociabilis (Vieillot)

An adult ♀, the second specimen to be recorded from the Santa Marta region, was collected in a small swamp near Rio Frio on February 24. Unless I am mistaken in my field identifications, which is not likely in view of the bird's distinctive, slender beak, this is a rather common species in certain restricted localities such as along the railroad just north of Aracataca and in the fresh swamps at Cienaga. It is, of course, a sluggish bird, usually to be seen perching low down in open

places. Near Rio Frio it is very rare. Fresh snail shells (*Ampularia*) which had doubtless been dropped by this kite were found under a fence post in a swampy field on Patuca Farm, between Tucurinca and Sevilla, in the spring of 1929.

13. Accipiter bicolor bicolor (Vieillot)

One ♂ and one adult ♀ of this woodland species were secured. The ♀, shot March 10 in the heaviest patch of forest remaining near Rio Frio, had an egg practically ready to lay in the oviduct. In exactly the same locality during the rains of 1928 (October or November) a "blue and buff hawk," perhaps the same bird, had been attracted as I was squeaking up an ant-bird, but had escaped.

14. Heterospizias meridionalis meridionalis (Latham)

This big, reddish hawk is fairly common in stump land, rough pastures, and other open places where there are convenient perches. It looks and acts like a large *Buteo*. In my experience it is not especially partial to water, although it does sometimes occur near swamps.

15. Urubitinga anthracina anthracina (Nitzsch)

A striking species which is apparently confined, in the vicinity of Rio Frio, to the wooded river valleys of the lower foothills. Similar birds were noted in the fresh swamps at Cienaga, but they may have been *U. urubitinga* (Gmelin), which is hardly to be distinguished in life. An individual probably of *anthracina* was seen flying down the valley of the Quebrada Mateo near Rio Frio on March 31, carrying a large toad in its claws. The hawk's call is a weak, repeated cry. No skins were made of this species, but it has been identified from the description and measurements of a bird shot near Rio Frio on March 25.

16. Asturina nitida costaricensis Swann

Asturina nitida nitida Todd and Carriker.

In the Museum of Comparative Zoölogy, there are three adults of *Falco nitidus* Latham from the collection of Mr. T. E. Penard. They are from near Paramaribo, Surinam. These are probably true *nitidus*, which was described from Cayenne, and are distinctly darker than Santa Marta birds both above and below. Santa Marta specimens agree fairly well with the type and two other skins of *A. n. costaricensis* Swann, but average slightly paler and larger. The differences, however,

seem to be too slight and inconstant to be recognized in nomenclature. The following adult specimens have been examined in reaching these conclusions:

A. nitida nitida

No.	*Sex*	*Locality*	*Wing*
M. C. Z. 143,057	[♀]	Vic. of Paramaribo, Surinam	257 mm.
M. C. Z. 143,061	♀	" " " "	253
M. C. Z. 143,063	♂	[" " " "]	231

A. nitida costaricensis

M. C. Z. 117,983 (type)	♂	Pozo del Rio Grande, Costa Rica	237 mm.
M. C. Z. 107,080	♂	Loma del Leon, Panama	232
M. C. Z. 14,729	[♀?]	Isthmus of Panama, Atlantic side	245
M. C. Z. 141,821	[♂?]	Rio Frio, Santa Marta, Colombia	241
Carnegie M. 42,676	♂	Fundacion, Santa Marta, Colombia	238
Carnegie M. 44,376	♂	Don Diego, " " "	242
Carnegie M. 42,961	[♂]	Fundacion, " " "	235
Carnegie M. 42,914	♀	Fundacion, " " "	245
Carnegie M. 42,595	♀	Mamatoco, " " "	258

The so-called Shining Buzzard Hawk is a fairly common species which looks and acts like a *Buteo*, keeping generally to partly open localities where there are perches. A pale gray (adult) individual shot in forest near Rio Frio in January dropped the remains of a young iguana. A specimen shot January 1, but later destroyed by ants, was molting from the brown to the gray plumage and reducing the number of bars in its tail.

17. Rupornis magnirostris insidiatrix Bangs and Penard

Rupornis magnirostris insidiatrix is one of the characteristic species of stump land, forest borders, and other semi-open places in the Santa Marta region. It is a rather small, *Buteo*-like bird and is very sluggish and conspicuous. Its frequently uttered call is a succession of loud yells.

18. Busarellus nigricollis (Latham)

A scarce bird except in the fresh swamps near Cienaga, where it is often encountered. One was seen in the mangroves along the Cienaga Grande at Sevillano on January 20. One was noted at Sevilla in October and one near Rio Frio in November. The identification has been made from the description of a bird shot January 3 at Rio Frio, but not skinned. This species is almost invariably seen over water. It has a harsh, rattling note.

19. Oroaëtus isidori (Des Murs)

Two individuals of this crested eagle were seen near Rio Frio, both in the deep, wooded valley of the Quebrada Mateo between 500 and 1,500 feet. The first, an adult ♂, was secured February 17 and roughly skinned with a machete for transportation. The second, a predominantly white (immature) bird, was shot March 17 but unfortunately could not be preserved. Both birds were found perching low down in nearly leafless, deciduous forest.

Family FALCONIDAE. Hawks, in part

20. Herpetotheres cachinnans cachinnans (Linné)

The Laughing Hawk is scarce but not rare near Rio Frio, where it is usually to be found in scattered trees in pasture land.

21. Micrastur melanoleucus melanoleucus (Vieillot)

Micrastur brachypterus brachypterus Todd and Carriker.

Forest undergrowth is the cover most frequented by this *Accipiter*-like hawk, which is fairly common in pairs near Rio Frio. On one occasion, I shot a bird which dropped the body of a little owl (*Glaucidium*).

22. Falco albigularis Daudin

Falco albigularis albigularis Todd and Carriker.

Bat Falcons were seen three or four times in stump land near Rio Frio, where an adult ♂ was collected on August 24. The birds seemed to be as active by day as the other members of the genus.

23. Falco fuscocaerulescens fuscocaerulescens Vieillot

Two specimens of this species were secured in open country near Rio Frio, an adult ♀ on July 31 and an adult ♂ on October 16. The species is an infinitely more agile and powerful flier than are the smaller local falcons.

24. Falco sparverius isabellinus Swainson

Sparrow Hawks are common but somewhat local from Cienaga to Aracataca, and one was once seen in the United Fruit Company's *Prado* in Santa Marta. I have seen the bird both carrying and eating lizards. In general *isabellinus* behaves like our New England race.

25. Polyborus cheriway cheriway (Jacquin)

Caracaras are characteristic of the open country, where they may sometimes be seen feeding with vultures on carrion. They have several harsh, rattling notes. The Colombians call them "Dio Pio" or "Garrapatero," but I did not see the birds looking for ticks on cattle. During October several families of adult and obviously young birds were seen in the banana fields.

26. Milvago chimachima cordata Bangs and Penard

The *Milvago* occurs in the same sort of places as the preceding species, with which it shares the name "Dio Pio." The two birds look very much alike in flight, but the present one, of course, is smaller and lacks the black crest of the other.

Family TINAMIDAE. Tinamous

27. Crypturellus soui mustelinus (Bangs)

Crypturornis soui mustelinus Todd and Carriker.

An adult ♂ was collected in rather heavy forest near Rio Frio on December 3. Other birds probably of this species, but perhaps in some cases the following, were shot for the table in the same general locality on January 10, February 14 (two), February 23, and March 10.

The little tinamous live on the ground in forest underbrush and dense second-growth, where they are almost impossible to secure during the rainy season. When the dead leaves on the forest floor have dried, however, the birds can be heard walking about and can be killed rather easily. They are very graceful, and move more like rails than fowls. The Colombians call them "Gallinetas del Monte," or "Little Bush Chickens."

28. Crypturellus cinnamomeus idoneus (Todd)

Crypturornis idoneus Todd and Carriker.

An adult ♂ was collected September 22, 1928, about two miles southeast of Rio Frio, thus extending the known range of the race well to the south of the town of Santa Marta. The bird was brooding a set of three eggs. The nest was a slight depression on the ground under a mass of brush and vines in a small opening in heavy forest and was discovered by the merest accident. When I first approached, the tinamou shot up like a rocket for about twenty-five feet, leveled off,

and disappeared instantly. It was secured eventually only by shooting at a mark placed before the nest. One of the eggs was broken, the others are "pale vinaceous-faun" by Ridgway's Color Standard, are very uniformly colored and rather glossy, and measure 47 × 38 and 46 × 38 mm. The embryos were only a little developed. The testes of the brooding ♂ were about 20 mm. long.

Family PERDICIDAE. Quail

29. Colinus sonninii decoratus (Todd)

Eupsychortyx leucopogon decoratus Todd and Carriker.

Dry, thorny scrub, grassland, and the borders of banana lots all offer satisfactory cover to the local quail, which is consequently an abundant bird. The Colombians call it "Cordoní." It goes in pairs and coveys and acts and calls like out northern Bobwhite. Where it is common it provides excellent hunting. Near Rio Frio the birds roost in coveys a few feet above the ground in dense masses of brush or the borders of woodland. A ♀ shot September 15 at Donjaca had an egg nearly ready to lay, and nearly grown young were killed several times in November, but this is not the only breeding season, for a downy, peeping young bird was found near Sevillano February 20, in company with four actively flying and presumably adult individuals. On the same day a partial albino adult ♂, with white feathers among the secondaries, tertials, and greater wing coverts, was shot from a covey of about seven normal individuals. In addition to the albino, only one bird, a normal adult ♂ from Aracataca, July 1, was preserved.

Family CRACIDAE. Curassows

30. Ortalis garrula (Humboldt)

A common species in the worst sort of second-growth and bushy forest, where it is usually flushed from the dense tops of low trees. In the early morning and evening the birds find commanding perches in leafy tree tops and indulge in series of rattling cackles, from which the Colombians get the local name of "Guacharáca." I have seen as many as four birds in one tree at this time, and think that two or more often call together. Their cackling can be heard easily half a mile away. Although the species advertises so effectively, it is wary and extraordinarily hard to shoot, for it usually glides off with a tree between itself and the hunter. Only a single specimen was collected, an adult ♂ at Rio Frio, March 11.

31. Penelope aequatorialis Salvadori and Festa

In the neighborhood of Rio Frio this guan seems to be restricted to the foothills of the Sierra Nevada, where it is fairly common at low altitudes. Its habit of squawking and flying only a short distance when flushed has probably caused its destruction on the coastal plain. The only specimen collected was shot February 17 at about 1,500 feet in the Rio Frio foothills, in a wooded valley where it had been feeding on small berries. A tame bird was seen walking with chickens in a yard in Aracataca, March 3. The local name is "Pava."

32. Crax alberti Fraser

A single pair of the big *Crax* curassow was seen soon after I reached Colombia, probably in March or April, in the foothills along the Rio Frio River. The birds were on the ground in open forest. Feathers of a fresh kill were found in the Quebrada Mateo about two miles east of Rio Frio on December 7, and feathers were seen on several other occasions, attesting the fact that the bird is much hunted locally. On March 3, a male and two females were seen in a pen at Aracataca and were said to have been caught near by. The Colombian name is "Pajuil" (pronounced pă-whéel), which may be a contraction of Pava Real, or Royal Pheasant.

Family ARAMIDAE. Courlans

33. Aramus scolopaceus scolopaceus (Gmelin)

These birds are common about marshy land, in wet and dry meadows, and even in banana lots. They run well on open ground and often alight on trees or banana *cepas* when flushed. Birds were noted at Cienaga, Orihueca, Tucurinca, Sevilla, Aracataca, and Rio Frio, where an adult ♂ was collected October 16.

Family RALLIDAE. Rails

34. Aramides cajaneus cajaneus (Müller)

Aramides cajaneus chiricote Todd and Carriker.

The common Wood Rail is to be found from Aracataca to Santa Marta wherever there is dense cover near swamps or wet ditches. It certainly is not confined to heavy forest. It is, however, a shy bird which greatly prefers running to flying, so that it is easily overlooked.

An adult ♂ was collected at dusk, October 2, as it was walking up a nearly horizontal limb several yards above the ground in a small patch of woods near Rio Frio. Almost all my other records were made during the dry season, when the birds are apparently forced more into the open to find food.

Porzana carolina (Linné)

The Sora Rail is a common winter resident in the fresh cat-tail (*Typha*) swamps near Cienaga. It was not seen in any other locality. Two birds were collected, one on November 17 and the other, an adult ♂, on February 27, while the species was noted also on November 24 and April 13.

35. Porzana albicollis (Vieillot)

Porzana albicollis is a plainly colored rail about the size of *P. carolina*. It was seen only in an area of low reeds and grass on the edge of a cat-tail swamp northeast of Rio Frio. An adult ♀ was collected on August 21 and several other individuals were flushed and shot for the table about the same time, but special search in the same place later, during the dry season, failed to reveal a single bird. The specimen secured seems to be the first to be recorded from the Santa Marta region.

Porzana flaviventer bangsi, subsp. nov.

Type.—Museum of Comparative Zoölogy, no. 141,831; adult ♂, from Cienaga, Magdalena, Colombia, April 13, 1929, P. J. Darlington, Jr.

Characters.— Differs from *P. f. flaviventer* (Boddaert) in having the breast and sides of the neck with a much paler buffy wash. Differs from *P. f. gossii* (Bonaparte) in having the upper wing coverts, rump, and interscapular region markedly blacker, less brownish, and more spotted or streaked with white.

Measurements (in millimeters)

No.	*Sex*	*Wing*	*Bill*	*Tarsus*
M. C. Z. 141,831 (type)	Ad. ♂	64	16	22
M. C. Z. 141,832	Ad. ♂	63	—	23
M. C. Z. 141,833	Ad. ♀	65	16	22

Material examined

Porzana flaviventer flaviventer (Boddaert). One ♀ (no. 560 Penard Coll.) from near Paramaribo, Surinam, April 28, 1914. One, sex not determined (M. C. Z. 74,374), from the same locality. One, sex not de-

termined (M. C. Z. 88,779), from the Lafresnaye Collection, said to be from Brazil.

Porzana flaviventer bangsi Darlington. Two, ♂♀, from Cienaga, Magdalena, Colombia, April 13, 1929. One ♂ from the same locality, February 27, 1929.

Porzana flaviventer gossii (Bonaparte). Ten, ♂♂♀♀, from Jamaica; six, ♂♂♀♀, from Cuba; all in the collection of the Museum of Comparative Zoölogy.

All the specimens listed above except the two undated skins of *P. f. flaviventer* are labeled as having been collected in January, February, March or April, so the Santa Marta series is seasonally comparable.

Cayenne is the type locality of *Rallus flaviventer* Boddaert, which was based on Daubenton's Plate 847, Pl. Enlum. The three birds from Surinam and Brazil listed above agree fairly well with Daubenton's plate. The Cienaga birds are similarly colored above to typical *flaviventer* but are much paler below, as pale, in fact, as *P. f. gossii* (Bonaparte) from Jamaica and Cuba. *Gossii*, however, is much browner, less black, above, and is much less marked with white. This character is shown best on the upper wing coverts but is evident enough on the rump and interscapulars, although a single ♂ of *gossii* from Jamaica (M. C. Z. 122,878) is darker above than the rest of the series and approaches the characters of the Colombian race. There is no significant geographical variation in size in the material examined.

It gives me great pleasure to name this bird in honor of Mr. Outram Bangs, whose work on the birds of Santa Marta is well known, and to whom I am indebted for the identification of most of my collection from that region.

This tiny rail was frequently flushed from grass and floating vegetation in the Cienaga fresh swamps during the fall of 1928, but the first specimen was not collected until the following February. The birds are extremely reluctant to fly. On one occasion I had to tramp through a patch of brush, some four feet square, three times in order to flush one. It seemed almost incredible that it could hide so long under such circumstances. During the dry season, when the area of floating grass and weeds is much reduced, the species probably retreats to the cat-tails. At any rate, the pair which was obtained April 13 was feeding in grass on solid ground at the edge of a bit of open water, but flew into cat-tail cover as I approached.

Creciscus albigularis (Lawrence)

Although there are several records for the White-throated Crake from different parts of the Santa Marta region, I met with it only in

the fresh swamps at Cienaga. It was commoner there than the Sora Rail, and occurred in tangled brush and weeds as well as in the cat-tails, so that two specimens were collected without difficulty, an adult ♂ on November 10 and a ♀ on February 27. The bird flushes rather easily for a rail but can be approached closely and observed by proper stalking in the cat-tail beds.

36. Gallinula chloropus pauxilla Bangs

The only adult gallinule which was collected (at Cienaga, October 6) proves to belong to this species, one not before recorded from the Santa Marta region. Unfortunately my field notes do not distinguish between this and the following species. One of them is abundant in the fresh marshes at Cienaga, where it feeds along the edge of the swamps and takes noisy refuge in the cat-tails when alarmed. Mr. Bangs says that this habit of retreating to cover is characteristic of the Florida Gallinule, and that the Purple more commonly climbs into a tree when it sights danger, as did the immature "Purple" which I shot. This does not definitely settle the matter, however. Gallinules of one species or the other occasionally showed themselves near Rio Frio. They were scarce there during the rains but fairly common in suitable localities during the dry season, when they were probably forced into the open in their search for food. Of the specimen of *pauxilla* collected at Cienaga, an adult ♂, Mr. Bangs writes, "This is an exact match for the one in the original series from western Colombia."

Ionornis martinicus (Linné)

An immature ♂ Purple Gallinule was collected March 9 in the fresh swamps at Cienaga. For further notes which may apply in part to this species see under *Gallinula chloropus pauxilla* Bangs.

Family RECURVIROSTRIDAE. Stilts, etc.

Himantopus mexicanus (Müller)

Black-necked Stilts were seen near Cienaga in November and were common along the edge of the Cienaga Grande near Sevillano during the fall of 1928. They were noted at Sevillano on January 20 too, but none was seen there during a brief visit February 20. In the fresh swamps at Cienaga one was seen March 23, two March 26, and about eight April 13. The species seemed to be much less common during the

dry season (our winter) than during migrations. No specimens were taken nor are any notes available on the bird's occurrence during the summer months.

Family SCOLOPACIDAE. Sandpipers, etc.

Bartramia longicauda (Bechstein)

Two Upland Plover, one of which (sex not determined) was collected, were seen in the semi-arid area at Sevillano on October 20. The birds were flushed from the dry ground amid clumps of giant cacti and thorny, acacia-like trees. This seems to be the second local record for the species.

37. Actitis macularia (Linné)

The Spotted Sandpiper is a fairly common winter resident, of which two specimens were collected, a ♂ (not yet in winter plumage) along the beach at Donjaca, September 15, and a ♀ (in first winter plumage) on sand and gravel bars of the Rio Frio River near the town September 9.

38. Tringa solitaria solitaria Wilson

The first migrant waders which I saw in the Santa Marta region (near Cienaga, August 11, from the train window) appeared to be Solitary Sandpipers, which were abundant during the winter at Cienaga, Sevillano, and Rio Frio. The only specimen actually collected, however, was at Cienaga, November 10.

Totanus flavipes (Gmelin)

Neoglottis flavipes Todd and Carriker.

One Lesser Yellow-legs was collected in the fresh swamps at Cienaga, March 9. This is a ♀, and seems to be the first spring bird to be secured near Santa Marta, although the species has been recorded several times in the fall.

Catoptrophorus semipalmatus inornatus (Brewster)

Several groups of two or three Willets each were seen on small beaches along the coast of the Caribbean, near Donjaca, on September 15. A ♂ was collected. There seem to be no previous records for the species from the Santa Marta region.

Capella jamesoni (Bonaparte)

During the writer's ascent in July, 1928, to the northwestern *páramo* of the Sierra Nevada de Santa Marta two of these snipe were flushed from a slope of sparse grass near 12,000 feet. This was during the rains. On the second ascent, during the dry season in February, 1929, two of the birds were again seen, this time in a swampy place beside a small lake at an estimated altitude of 13,000 feet. Three *Capella delicata* were present at the same place, and showed by comparison the great size of *jamesoni.*

39. Capella gallinago delicata (Ord)

Capella delicata Todd and Carriker.

This winter resident, which is, of course, our Wilson's Snipe, ranges in suitable localities from the mangrove border of the Cienaga Grande, through the fresh swamps of Cienaga and Rio Frio, to the slopes of the Sierra Nevada and up to the *páramo* zone, where three were seen beside a small lake near 13,000 feet on February 10. The species is nowhere very common, although half a dozen or so birds may sometimes be put up almost together. It was first met with at Sevillano on October 20, when my only specimen, an adult ♀, was collected. It was noted at Rio Frio several times in November, but disappeared from this locality during the dry season. It was seen in the fresh swamps at Cienaga at various times during November, February, and March.

Family CHARADRIIDAE. Plovers

Charadrius collaris Vieillot

Charadrius semipalmatus Bonaparte

Two or three species of plover occur together on the mud flats along the Cienaga Grande near Sevillano, where one specimen each of *collaris* and *semipalmatus* were collected October 13. *C. collaris* is the commonest plover locally, but *C. semipalmatus* is not rare during the winter, and *Pagolla wilsonia crassirostris* (Spix) has been recorded from Cienaga.

Belonopterus cayennensis cayennensis Gmelin

An adult ♂ was collected from a flock of four at Aracataca, July 1, and birds were seen occasionally, usually in threes or fours, at Cienaga and Sevillano. They frequent open wet places such as flood pools,

swamp margins, and wet pastures, and run less and fly more than the smaller plovers. The birds are easily identified by their "prominent foreheads," short occipital plumes, and characteristic screaming notes.

Family ARENARIIDAE. Turnstones

Arenaria interpres morinella (Linné)

Turnstones were seen only on September 15 on rocky headlands along the sea coast near Donjaca, where a single ♂ was secured. Several flocks of fifteen or twenty birds each were present. The species is an addition to the Santa Marta list.

Family BURHINIDAE. Thick-knees

Burhinus bistriatus vocifer (L'Herminier)

Oedicnemus bistriatus vocifer Todd and Carriker.

A single flock of four of these big, fast-running birds was encountered November 24 on a flat, nearly bare plain just at the edge of the Cienaga fresh swamps. An adult ♀ was secured here and seems to be the first specimen of the species collected in the Santa Marta region, although Carriker noted it on the other side of the mountains, at Rio Hacha and Camperucho, in July and August, 1920.

Family JACANIDAE. Jacanas

40. Jacana nigra (Gmelin)

The Jacana is abundant in all open wet places, and simply swarms in the fresh swamps at Cienaga. A distinct increase in the number of birds at Rio Frio was noted when the dry season set in. Like the Gallinules and Wood Rails these birds were probably forced to range more widely in search of food at this time, and may have been attracted to Rio Frio by the small marshes which were maintained by overflow from the irrigation canals. White-bellied (immature) Jacanas were seen in every month from October to April.

Family COLUMBIDAE. Pigeons

41. Leptotila verreauxi verreauxi Bonaparte

Leptotila verreauxi is the commonest local game pigeon, and is found in almost every type of habitat from the semi-arid area to the forests

of the plain, and up to at least 2,000 or 3,000 feet in the mountains above Rio Frio. It usually feeds on the ground in pairs or small flocks, but alights in low trees when flushed. It is not particularly shy. During the dry season the birds often scratch about in the dead leaves on the forest floor, so that the hunter must train his ear to distinguish them from the little tinamous.

42. Claravis mondetoura mondetoura (Bonaparte)

A ♀ of *C. mondetoura* was secured near Rio Frio in the wooded valley of the Quebrada Mateo just within the edge of the foothills, March 17, 1929. This seems to be the first record for the Santa Marta region. The bird is said to be rare throughout its range.

43. Claravis pretiosa livida Bangs

Claravis pretiosa Todd and Carriker.

The Blue Ground Dove is typically a forest bird, but it often feeds on the ground in bushy and overgrown pasture land. In the Santa Marta region the birds are very local. They are not uncommon, however, near the foothills of the Sierra just south of the Rio Frio River, where a pair was collected in October. With the possible exception of *C. mondetoura*, this is the shiest of the smaller local doves.

44. Columbigallina rufipennis rufipennis (Bonaparte)

Small size, reddish coloration, and a gray head distinguish this abundant, ground-feeding dove, which inhabits all sorts of open and semi-open places near Rio Frio. If it were a trifle larger, its confiding habits would make it a favorite game bird with the Colombians, but fortunately it is not considered worth the cost of ammunition. The nests are commonly placed a few feet above the ground in tangled bushes, but one was found in the axil of a leaf on a corn stalk and one tucked into a clump of grass. There is a nesting period in October and November, but I saw at least four pairs of birds mating in December and found a nest with two eggs December 26, while the Smith expedition secured nests at Bonda in April and June.

45. Columbigallina passerina albivitta (Bonaparte)

During the rainy months this bird, the smallest and one of the tamest of the local doves, was not seen near Rio Frio, but several small flocks were noted southeast of the town on February 19, March 10,

and April 7. This region had been worked thoroughly during October and November, for it could be reached when only one or two hours were available for collecting, so the bird could hardly have been overlooked at that time. The natural habitat of the species is, of course, the semi-arid area, where it feeds on the ground amid the patches of thorny scrub, but Carriker found it at Fundacion during the rains. Nevertheless, I believe that all the birds at Rio Frio were local migrants from a few miles north. Obviously young birds were seen with adults at Sevillano, October 20, and my only specimen was collected at the same place January 20.

Scardafella squammata ridgwayi Richmond

The long tail and squamate markings are field characters sufficient to distinguish the *Scardafella* near Santa Marta. The bird is restricted to the scrub of the semi-arid area, where it was first encountered on October 13 near Sevillano. Three individuals were present, one of which, an adult ♂, was collected. A bird was seen at the same locality February 20, and one was noted at Cienaga November 24.

Columba gymnophthalmos Temminck

Crossophthalmus gymnophthalmos Todd and Carriker.

This fine pigeon, easily distinguishable in the field by its white wing mark, is found only in the semi-arid area where cacti and acacia abound. It was fairly common in small flocks at Donjaca, September 15, when an adult ♀ was collected, and was noted also at Cienaga and occasionally as far south as Sevillano. It is usually seen perching on the top of a Giant Cactus or a low tree.

46. Columba speciosa Gmelin

Lepidoenas speciosa Todd and Carriker.

One or more small flocks of *Columba speciosa* inhabit the low, dry forest near the foothills of the Sierra Nevada southeast of Rio Frio. An adult ♀ was collected at this place on August 5. This species is extremely shy and is usually flushed from the tops of small trees — indeed it was never seen on the ground. The local name is "Torcáza," while the various other local doves and pigeons are all called "Palóma."

47. Columba rufina pallidicrissa Chubb

Chloroenas rufina pallidicrissa Todd and Carriker.

This is a large, common, tree-feeding pigeon which ranges in the more open localities from the semi-arid area to the low pastures along

the Aracataca and Fundacion Rivers. It is one of the standard game birds of the region. I was told by reliable observers that it sometimes feeds in huge flocks on the white "uvitas," small, berry-like fruits which are borne on a low tree. The only specimen preserved is an adult ♀ from Cienaga, March 9.

Family PSITTACIDAE. Parrots

48. Amazona ochrocephala panamensis (Cabanis)

Amazona amazonica amazonica (Linné)

The only *Amazona* which I collected (at Aracataca, July 1) is an *ochrocephala panamensis*, but to judge from Todd and Carriker most of the individuals at Rio Frio must have been *A. amazonica*. Amazons are common over most of the coastal plain between the Sierra Nevada and the Cienaga Grande. In the dry regions they are found in the higher scrub or are seen flying over; further south they are usually met with in forest. Like the macaws they fly in pairs, several pairs often uniting to form a loose flock. The genus is surprisingly scarce in the immediate neighborhood of Rio Frio, but this may be due to the Colombians, who consider the birds excellent eating. The local name is "Loro."

Amazona mercenaria (Tschudi)

The mountain Amazon was common in forest from about 8,000 feet up to tree line below the northwestern *páramo* of the Sierra Nevada in both July and February.

49. Pionus menstruus (Linné)

An abundant, forest-dwelling species which often occurs in flocks of twenty-five or more and is very noisy. Occasionally it enters the outskirts of Rio Frio, but it is too shy to do much damage. An adult ♂ collected near the town June 14 has the front and part of the crown red, the color being asymmetrical.

50. Forpus spengeli (Hartlaub)

Psittacula spengeli Todd and Carriker.

This miniature parrot occurs rather sparingly in the forest and semi-open near Rio Frio and in the shade trees of the town, but is commoner in open forest at Aracataca and in the cactus thickets at Sevillano.

An adult ♂ was collected at the latter locality on September 1. For further notes on the local distribution of the species see the introductory discussion of this paper. The birds go in small flocks and may be located by their chattering calls, which are sparrow-like with a parrot quality.

51. Brotogeris jugularis jugularis (Müller)

One of the first and most attractive of the tropical birds which the casual visitor will see in the Santa Marta region is this small, orange-chinned, green parrot, which is abundant in the shade and fruit trees of the various towns. It is equally common in the semi-open country, where it is partial to the *Cecropia* tree. It has a variety of chattering notes and a pleasing, two-syllabled whistle. In the spring the birds do much damage to mangoes and *avocates*, which they raid in large, noisy flocks. The flocks are so bold that I have sometimes had to shoot into them three or four times in order to drive them away. This and the other small local parrots are lumped by the Colombians under the name "Perico."

52. Aratinga pertinax aeruginosa (Linné)

Eupsittula pertinax aeruginosa Todd and Carriker.

This noisy and conspicuous paroquet is common in the semi-arid region and in dry pastures to within three miles of Rio Frio on the north. It was not seen in the immediate vicinity of the town during the rains, but was noted there December 25, January 3, and on various dates in February and March, so that a partial seasonal migration is indicated. The birds usually go in flocks and can be identified at a distance, for none of the other small, lowland parrots have long tails.

Aratinga wagleri (Gray)

In July, several flocks of a small, long-tailed parrot, which could only have been *Aratinga wagleri*, were seen in semi-open country just below the edge of the subtropical forest zone along the mountain trail, some 4,000 feet above Rio Frio.

53. Ara militaris (Linné)
54. Ara chloroptera Gray
Ara ararauna (Linné)

The blue-green macaw (*A. militaris*) is the common bird of the coastal plain, the red species (*A. chloroptera*) was seen occasionally at

Aracataca and once each at Patuca Farm and Rio Frio, while the blue and yellow bird (*A. ararauna*) was encountered only once, at Patuca Farm. The blue-green species alone ranges into the foothills, where on one occasion I saw thirty-five scattered about the sky and feeding in trees on the wooded ridges. Anyone who is familiar with the birds can imagine the noise they made. All the local macaws are forest birds, almost invariably seen in multiples of two. They are hunted for food by the Colombians, who call them "Guacamáya," with or without distinguishing phrases based on color, and who have named the town of Guacamayál (near Sevilla) after them. I preserved one specimen each of *chloroptera* and *ararauna*, both collected on Patuca Farm, between Tucurinca and Sevilla, March 16, and have identified *militaris* from the description of a bird shot (but not preserved) near Rio Frio, August 3.

Family CUCULIDAE. Cuckoos

55. Crotophaga ani Linné

Crotophaga sulcirostris sulcirostris Swainson

C. s. sulcirostris was noted definitely only twice, once when a ♀ with a fully formed egg in the oviduct was collected in the mangroves near Sevillano, October 20, and once when a bird was seen in bushes by an *acequia* (irrigation ditch) near Aracataca, March 3. The two anis are not easy to distinguish by eye in the field, for it is hard to be sure of the presence or absence of sulci on the beak and the size difference is not great. There can be little doubt, however, that it is *C. ani* which is so abundant locally. It ranges from the Cienaga Grande to the edge of the foothills and occupies nearly every type of habitat except the heavy forest. The birds are called "Negrito" and "Santa Lucia" by the Colombians, and are so well known that a description of their habits is unnecessary. No nests were seen in Colombia.

56. Crotophaga major Gmelin

This big ani usually goes in small, shy flocks, which break out in noisy choruses at intervals. The notes are harsh and quite unlike those of the other anis. This is one of the species which was not seen outside of the semi-arid area during the rains, but which appeared near Rio Frio on January 14, and which was noted there repeatedly in February, March and April. During these months a small flock was resident in the trees along the river just above the town, where it could hardly have been overlooked if it had been present earlier in the year. I am,

therefore, reasonably sure that the Rio Frio birds were merely local migrants. All the birds had not left the semi-arid area at this time, however, for several were seen in dry scrub at Sevillano on February 20. The significance of the apparent migration of this and some other species is discussed in the introduction. Only one specimen was collected, at Sevillano, October 20, but the other records are trustworthy, for the bird is quite unmistakable.

57. Tapera naevia naevia (Linné)

The Striped Cuckoo is rarely seen in the Santa Marta region, perhaps because it prefers the densest thickets and is inconspicuously colored. I saw only four individuals: one in a bushy field at 1,500 feet elevation in the foothills above Rio Frio, July 22; an adult ♂ which was collected in an overgrown fence row near the town August 19; a young ♂ collected November 25 in tangled woods near by; and a bird seen calling from an open perch in stump land at Aracataca, March 3.

58. Piaya cayana columbiana (Cabanis)

Piaya columbiana Todd and Carriker.

Big Squirrel Cuckoos are common and conspicuous birds in the tangled woods and bushy fields of the plain and lower foothills near Rio Frio. They are by no means shy, and may be seen feeding on the ground as well as in masses of brush and low trees.

Coccycua rutila gracilis (Heine)

A small, rufous-brown cuckoo was seen in a thicket on the edge of a forest near the Rio Fundacion, below Aracataca, on February 26. It was very tame and was studied at close range. An examination of skins in the Museum of Comparative Zoölogy leaves little doubt that it was this bird, which has been recorded only once before from the Santa Marta region.

Coccyzus pumilus Strickland

A species which is apparently a swamp dweller, for it was seen only in tangled bushes in the fresh swamps at Cienaga. A tailless individual was collected there on October 6, and two adult females, both with well differentiated eggs in the ovaries, were secured February 27. There seem to be no previous records for the Santa Marta region.

The three Cienaga birds do not differ in size or color from two from Venezuela ("Caicara" and "El Cuji, Estado Lara") in the American Museum of Natural History.

59. Coccyzus lansbergi Bonaparte

I found this cuckoo as rare as previous records would indicate. It was first encountered in June, when a bird was killed in tangled, low forest near Rio Frio. The skin was discarded, for the tail had been shot out and the species was not recognized at the time. A second individual was seen soon afterward in the same locality, and an adult ♀ was collected August 26 in an overgrown pasture near by. No other birds were seen.

Coccyzus americanus americanus (Linné)

Coccyzus americanus Todd and Carriker.

A single ♀ Yellow-billed Cuckoo was secured November 10 in dry scrub near Cienaga. The date agrees with those of previously published records.

Family STRIGIDAE. Owls

60. Glaucidium brasilianum medianum Todd

This little owl is fairly common in dry forest and semi-open near Rio Frio. It is frequently mobbed by hummingbirds and such species as the ant-bird *Cercomacra nigricans*. It apparently lacks the rattling call of the Cuban *Glaucidium*.

61. Pulsatrix perspicillata perspicillata (Latham)

Two Spectacled Owls were seen and one collected in low, dry forest near Rio Frio, October 7, and two were seen again at the same place November 10. The single specimen is an adult ♀.

62. Otus choliba margaritae Cory

The two adult males of *Otus choliba* which were secured are referred to *margaritae* merely for the sake of consistency, for that name has been used by Todd and Carriker. One of the birds is in the rufous and the other in the brown phase, and both are distinctly paler than the corresponding phases of the more southern *crucigerus*. They are certainly extremely close to the Central American *luctisonus* Bangs, however,

as is shown by a comparison with the type series of the latter in the Museum of Comparative Zoölogy. Unfortunately the Museum has no adults of typical *margaritae*.

The local Screech Owl is rarely seen, but its call shows it to be a common bird on the coastal plain. It was first seen at Sevilla in June, when two were noted roosting in a bunch of bananas. On October 16, my boy knocked one down with a stone in a yard in Rio Frio, and I shot one in open forest near the town at dusk, January 11. This bird was calling at the time. The call is a short, bubbling chuckle ending in a rather high-pitched, one- or two-syllabled cry.

Family CAPRIMULGIDAE. Goatsuckers

Podager nacunda minor Cory

A loose flock of *at least* forty individuals was discovered September 1 at Sevillano. The birds were roosting on the open ground, in the full glare of the sun, where a broad strip of baked and salt-encrusted earth had been left between the Cienaga Grande and the vegetation of the neighboring desert. They could hardly have found a hotter place. It evidently suited them, however, for they were seen again in the same locality, but in somewhat reduced numbers, during November. A group of five was seen also at Cienaga on November 24, on a sun-baked plain which had been practically denuded by woodcutters. There was a thin mat of vegetation here in places, but the birds alighted indiscriminately on it and the bare ground.

When flushed, these goatsuckers rise uttering a clucking "pow, pow." They fly rather slowly and directly and usually without the zigzagging so characteristic of the family. When they settle again, they sit with their necks stretched up, cluck "pow" once or twice, bobbing each time, and then slowly contract to their usual position, when they are nearly invisible. They often freeze by a piece of dry cow dung or a stick, but never where there is more than the merest carpet of vegetation.

The adult ♀ collected at Sevillano September 1 seems to be the first specimen of the species to be recorded from the Santa Marta region.

63. Lurocalis semitorquatus semitorquatus (Gmelin)

Lurocalis semitorquatus is another addition to the Santa Marta list. It was seen over only a single area of freshly cut stump land near Rio

Frio, where an adult ♂ was collected in the evening of November 29. It had been feeding chiefly on small bugs and beetles. Several other birds were present at the same time. From the other local nighthawks this may be distinguished with some certainty by its dark color and short tail, while the beautiful silvery frosting of the greater wing coverts is a good character when the bird is in the hand.

64. Chordeiles minor aserriensis Cherrie

A single adult ♀ of the Aserri Nighthawk, which is also previously unrecorded from the Santa Marta region, was shot from a tree limb in open forest near Rio Frio on the afternoon of April 5. It was very fat. The bird is, of course, a migrant, which is known to breed in central southern Texas and northern Tamaulipas, Mexico.

65. Chordeiles acutipennis acutipennis (Hermann)

This nighthawk is locally common both in the semi-arid area near Cienaga and in the more humid country at Rio Frio. In the dry area it is occasionally flushed by day from the horizontal limbs of small trees, but near Rio Frio most of the birds appear to spend the day in the lower foothills of the Sierra Nevada. Nevertheless, an individual was flushed from a tree limb in open lowland forest on November 21, and another was seen in the same place February 23. The hill-roosting birds fly out over the coastal plain singly and in small groups just before sunset, hawking at first far out of gunshot, but later congregating and descending to some favored feeding ground. The evening migration from the hills was first noted on February 18, and three days later the first feeding ground was discovered. Here, in an open, wet pasture, bordered by a swamp, scores of the birds were quartering over the short grass and cat-tails, but not over the herd of cattle which was near by. On March 5 the species was again noted coming from the hills to the same pasture, and on different occasions, during March, birds were observed at dusk zigzagging over the town of Rio Frio, over the neighboring grass land and banana lots, and over the Rio Frio River. I have no notes on the occurrence or habits of the species from April through September. Although several specimens were shot, most of them by mistake for other species, time was found to skin only a ♀ from Cienaga, November 17, and a ♂ from Rio Frio, February 21.

66. Nyctidromus albicollis gilvus Bangs

By day the Santa Marta Parauque roosts on the ground in thickets or in the forest, where it is often flushed into moth-like flights of a few yards. During the evening it is abundant on paths and dry irrigation ditches in and near woodland. Its habits are too well known to need description here. A single specimen shot at Cienaga, November 27, was sitting crosswise on a small branch, a most unusual position for a goatsucker.

Systellura ruficervix (Sclater)

A bird which could have been only *Systellura ruficervix* was flushed from a single egg at an altitude of about 9,000 feet on the northwestern range of the Sierra Nevada de Santa Marta proper, February 12. The egg had been laid beside a log on nearly open ground.

Family MOMOTIDAE. Motmots

67. Momotus momota subrufescens Sclater

Momotus subrufescens subrufescens Todd and Carriker.

The local motmot is one of the common birds of the Santa Marta region. It is characteristic of bushy lowland forest and second growth, and usually keeps near the ground, but during November several birds were seen high up in *Cecropia* trees. One was noted at the entrance of a hole in the side of a deep irrigation ditch in the forest near Rio Frio in October. The bird's call is a low, bubbling chuckle, of which the Colombian name is an onomatopoetic derivation which may be rendered as "Bruréro," giving each "r" its Spanish value, which is distinct but not rolling, more like our "d" than our "r."

Family ALCEDINIDAE. Kingfishers

68. Chloroceryle inda (Linné)

A bird which was seen on only two occasions, both times in heavy forest near Rio Frio. An adult ♂ was collected beside a ditch November 13 and an individual was seen along the river at dusk April 9.

69. Chloroceryle americana americana (Gmelin)

This is a common bird which has the same local range as the next, except that it follows the small *quebradas* (brooks) further into the foothills of the Sierra.

70. Chloroceryle amazona (Latham)

Probably the commonest local kingfisher. It is abundant at Cienaga in the fresh swamps, occurs in the mangroves at Sevillano, and is to be found in numbers along the Rio Frio and the neighboring irrigation ditches. *C. amazona* is about the size of a Blue Jay, *C. americana* of a Bluebird, and *C. aenea* (which I did not see but which is known to occur in the Santa Marta region) of a small sparrow, while *Ceryle torquata* is the local giant of the family, and is, therefore, unmistakable. All the species are called "Pescadór."

71. Ceryle torquata torquata (Linné)

Megaceryle torquata torquata Todd and Carriker.

The Ringed Kingfisher is common along rivers and ditches near Rio Frio. It seems to have no unusual habits except that of traveling cross-country high out of gunshot, which the other species of the family were not seen to do.

Family BUCCONIDAE. Puffbirds

Malacoptila mystacalis (Lafresnaye)

The only individual seen was an adult ♂ collected in a patch of forest at about 2,500 feet elevation in the foothills above Rio Frio, July 29. All previous local records seem to have been from the San Lorenzo at not below 4,000 feet.

72. Hypnelus ruficollis ruficollis (Wagler)

The common puffbird is much more abundant in the dry region north of Rio Frio than in the woodland to the south, but is not rare anywhere. It is usually seen in pairs in scattered trees, open woods, or scrub, and is, of course, very sluggish and tame. It combines the appearance of a stupid kingfisher with habits much resembling those of flycatchers.

73. Notharchus hyperrhynchus dysoni (Sclater)

Notharchus hyperrhynchus subsp. Todd and Carriker.

Todd refused, entirely on geographical grounds, to refer his Santa Marta specimens of *N. hyperrhynchus* to *dysoni*, a procedure which does not seem worthy of being followed. The species is rare near Rio Frio, but an adult ♀ was shot from the top of a forest tree on June 20, and a bird was seen flying over the same patch of forest in November.

Family GALBULIDAE. Jacamars

74. Galbula ruficauda pallens Bangs

Like the common puffbird, with which I always associate it, this jacamar is most abundant in the drier parts of the plain, but is present wherever there are scattered trees or open woodland. In behavior it is rather flycatcher-like. It is a noisy bird with a peculiar, rigid profile in flight which is unmistakable, although the tremendously long, straight beak, long tail, and metallic green upper parts are in themselves more than sufficient field characters.

Family RAMPHASTIDAE. Toucans

75. Pteroglossus torquatus nuchalis Cabanis

Aracari Toucans are common in small flocks in forest and semi-open country near Rio Frio. Occasionally they enter the town and are seen in *avocate* and mango trees, but they cannot be considered destructive. They have an easily recognized "gasping" note of two syllables run together, not loud.

76. Ramphastos sulphuratus brevicarinatus Gould

The so-called Short-keeled Toucan is less common and more shy than the *Pteroglossus*, perhaps because it is considered *muy sabroso* by hungry Colombians. The species is usually found in small flocks, of from four to a dozen birds, in heavy forest. I have seen it at 4,000 feet in the mountains above Rio Frio, and Carriker found it even higher on the San Lorenzo. A specimen shot June 5 had two botfly larvae under the skin, one on the thigh and one on the body. The toucans are all called "Guasalé" and this species sometimes "Guasalé con Pico Verde," or Green-billed Toucan, a phrase which applies to the bird in life but not to museum skins.

Family PICIDAE. Woodpeckers

77. Picumnus cinnamomeus cinnamomeus Wagler

These tiny woodpeckers are rather common, confiding birds which are usually seen singly or in pairs climbing about in tangled vines and brush. They inhabit low forest and second-growth and range from the plains into the low foothills east of Rio Frio. The call is somewhat like

that of a Hairy or Downy Woodpecker but is, of course, not nearly so loud. On March 11, in woods near Rio Frio, four of these birds were driven from a fence post which had a tiny woodpecker hole near the top. On March 13, a flock of five and one single bird were noted in the semi-arid area near Sevillano.

78. Veniliornis kirkii cecilii (Malherbe)

The home of this very inconspicuous bird is in the heavy lowland forest, where it usually keeps well up in the trees. The call is a deliberate repetition of several high notes. The species is common.

79. Scapaneus melanoleucos malherbii (Gray)
80. Ceophloeus lineatus mesorhynchus Cabanis and Heine

These two fine woodpeckers were both frequently encountered in open forest near Rio Frio and were once or twice noted in the shade trees of the town. The *Ceophloeus* is probably the less abundant, but it certainly is not rare. I know that the calls of the two are very different, but cannot describe them except to say that both are loud and "woodpecker-like." These and the other local woodpeckers are all called "Carpintéro" by the Colombians, who sometimes, however, distinguish these birds as "Carpintéro Reál."

81. Chrysoptilus punctigula ujhelyii von Madarasz

Although there have been very few previous local records for *Chrysoptilus ujhelyii*, the species was noted on fully a dozen occasions at Rio Frio, Cienaga, and Aracataca. In the southern part of the region, it probably regularly inhabits open forest, but it seems more at home among the scattered trees in the dry pastures north of Rio Frio at least as far as Cienaga. It was seen also in shade trees in the town of Rio Frio. The call is notably unpugnacious for a woodpecker, and consists of a comparatively deliberate repetition of several soft, rather high-pitched notes. A bird seen October 27 was excavating a hole twenty-five or thirty feet above the ground in a dead tree in rough pasture land.

82. Piculus chrysochloros aurosus (Nelson)

Chloronerpes chrysochloros aurosus Todd and Carriker.

On July 8, one of these birds was collected and another apparently of the same species was seen near Rio Frio in a fringe of forest just where the Quebrada Mateo leaves the foothills.

83. Centurus rubricapillus rubricapillus Cabanis

A species which will certainly be seen by the ornithologically minded visitor. It is the most abundant woodpecker of the region, and is found in all sorts of semi-open places. It is common, for instance, in the scrub and cactus of the arid area and in the shade trees about the towns. The birds usually go in small, noisy "families." They have the peculiar habit of clinging motionless to an exposed branch, often in a dead tree or a *Cecropia*, during light rains. Nesting sites were noted in a fence post and in Giant Cactus.

Family TROGONIDAE. Trogons

84. Trogon violaceus caligatus Gould

Chrysotrogon caligatus columbianus Todd and Carriker.

The Gartered Trogon is not common near Rio Frio, although it is more frequently seen than the following species. It is usually found singly about half way up in the trees in fairly open forest. It has a five-fold call which is rather cuckoo-like and also a low clucking note which is accompanied by an upward lift of the tail.

85. Trogon melanurus macrourus Gould

Curucujus melanurus macrourus Todd and Carriker.

Near Rio Frio this is a scarce bird, usually to be found in pairs in the drier forest. It usually perches within three or four yards of the ground and is very tame. One individual was heard to utter an unmusical, clucking rattle which seemed to be an alarm note, while another confined itself to a low call.

Family MICROPODIDAE. Swifts

86. Chaetura andrei meridionalis Hellmayr

One specimen, an adult ♂, was secured at Rio Frio on August 8, 1928. It agrees in coloration with birds from Argentina and Brazil, and is just within the maximum size limit given in the original description of *meridionalis*, for the wing measures 135 mm. and the

tail 39 mm. The following specimens of *C. a. meridionalis* have been examined:

No.	*Sex*	*Locality*	*Wing*	*Tail*
M. C. Z. 99,258	—	Pto. Segundo, Prov. de Misiones, Argentina	128 mm.	38 mm.
Am. Mus. 140,708	♀	Embarcacion, Prov. de Salta, Argentina	122	36
Am. Mus. 140,707	♀	Embarcacion, Prov. de Salta, Argentina	124	36
Am. Mus. 163,159	♀	Bahia, Brazil	132	39 (?)
Am. Mus. 163,160	♀	" "	138	39
M. C. Z. 141,901	♂	Rio Frio, Santa Marta, Colombia	135	39

These measurements agree well with those given by Hellmayr [1] in his paper on the South American swifts. No specimens of typical *Chaetura andrei* have been seen, but the bird inhabits Venezuela and is described as having a wing of from 114.5 to 117 mm.

The capture of a large specimen of *C. a. meridionalis* in northern Colombia not only greatly extends the known range of the race, but at first glance seems to indicate a discontinuous distribution, with typical *andrei* occupying the middle ground. It is possible, however, that *meridionalis* may occur in the intermediate country west of Venezuela, or that it may breed in a different altitudinal zone from *andrei*. It is also possible that individuals of the southern race occasionally migrate to the north, as *Phaeoprogne tapera fusca* Vieillot is thought to do.[2]

On the coastal plain west of the Sierra Nevada flocks of small swifts are to be seen from time to time, although on many days they seem to be completely absent. Several species are probably represented. *Chaetura andrei meridionalis* is, of course, new to the Santa Marta list.

87. Streptoprocne zonaris albicincta (Cabanis)

Big, collared swifts descend a dozen or so times a year to the plains near Rio Frio, during both the wet and the dry seasons, and were noted at Aracataca in February and March. They invariably travel in flocks, which on some days fly far out of range and on others come near the ground. Although a good series could easily be secured on the latter occasions, no attempt was made to get more than a single specimen, an adult ♀, at Rio Frio, November 11. In the foothills, flocks of fifteen

[1] Verk. Ornith. Ges. Bayern, **8**, 1908, p. 145.
[2] Chapman, The Auk, **46**, 1929, p. 348.

or twenty birds may be seen cruising at high speed over the ridges and valleys and uttering a medley of chattering calls.

Family TROCHILIDAE. Hummingbirds

88. Chrysolampis elatus (Linné)

Near Rio Frio, in October, this was an abundant species at certain flowers in bushy, forest-bordered fields, but it was not, I think, seen anywhere else. A ♂ with the yellow throat coming in in patches was shot in October, but could not be preserved. The yellow throat, orange-gold cap, and coppery tail of the male make it an unforgettably vivid bird when it is seen poised in sunlight.

89. Acestrura astreans Bangs

Chaetocercus astreans Todd and Carriker.

The only individual of the minute, short-tailed *C. astreans* which was definitely identified was shot on the edge of a forest beside a field of flowers near Rio Frio, October 16, at less than one hundred feet above sea level. The specimen weighed only 2.30 gm. two and a half hours after death, when the body had probably not dried out much. It is probably a young ♂, for the tail is tipped with white and the back is bluer and the bill more slender than in the female. This record, combined with those of Simons for Atanquez and of the Smith Expedition for Bonda, indicates a more or less regular descent of the species from the mountains to the plain, or at least to the lower tropical zone. From this, and from the scattered localities given by Todd and Carriker for some other species, one gets the impression that there is still a great deal to be learned about the seasonal migrations of several of the local hummingbirds.

90. Florisuga mellivora (Linné)

The Jacobin was first seen at wild plantain flowers at about 3,500 feet elevation in the mountains, July 15. This individual was the only one collected. The species was recorded twice near Rio Frio, however, once in September and once in November. The second bird was hovering over an irrigation ditch in a pasture and evidently securing insects from the water surface. The species was locally common in banana lots just north of Sevilla in October.

Helianthea phalerata (Bangs)

In February, on the northwestern slope of the Sierra Nevada above Rio Frio, Bangs' Helianthea was fairly common between 6,000 and 9,000 feet. The birds were feeding at the flowers of the bromelias which grew both on trees in the forest and on the ground in bushy meadows.

91. Chlorostilbon chrysogaster (Bourcier)

Chlorostilbon haeberlinii Todd and Carriker.

As far as field characters go this tiny, glittering-green bird is almost an exact miniature of *Sapphironia coelina.* It probably has similar habits, for males were seen only at flowers in a bushy field near forest, where the larger species was common. A single ♀ was collected in forest near Rio Frio, November 25, and an adult ♂ was secured at the flowers mentioned, October 16.

Sapphironia caeruleigularis duchassaingi (Bourcier)

Lepidopyga coeruleogularis Todd and Carriker.
Lepidopyga lilliae Todd and Carriker.

According to Simon in his Histoire Naturelle des Trochilidae, this is the proper name to use for the Santa Marta bird with the throat purplish-blue in the male. Two specimens with the blue extended over the abdomen served as the types of *Lepidopyga lilliae* Stone, which is synonymous. The subspecies *duchassaingi* ranges west to Panama, but is replaced by typical *caeruleigularis* farther north. In the Santa Marta region the bird is restricted to the semi-arid area, from which it occasionally invades the mangroves. The blue-bellied phase (*lilliae*) is not restricted to the latter, of course, and I have seen it (although unfortunately I had both barrels loaded for pigeons at the time) in an acacia thicket at the exact locality where a normal, blue-throated male was later collected. Two adult males, with blue only on the throat, were eventually secured at Sevillano on October 20 and January 20. Mr. Bangs suggests that possibly very old birds acquire the entirely blue underparts.

92. Sapphironia coelina (Bourcier)

Lepidopyga luminosa Todd and Carriker.

A forest-dwelling species which is sometimes fairly common near Rio Frio at flowers in bushy fields near woodland. A specimen was taken, too, at Aracataca. In using the name *coelina* for the green-bellied species, I am following Simon.

93. Damophila juliae juliae (Bourcier)

This is a forest bird of which only two individuals were seen near Rio Frio. Both were secured, a ♂ October 27 and a ♀ November 11. The latter was flushed from a compact, typical hummer's nest in the fork of a bush about four feet above the ground in woodland, and had been brooding two white eggs. These measure 13 × 8 mm.

94. Colibri delphinae (Lesson)

A species which was noted only at flowers on the edge of forest southeast of Rio Frio. Not more than four birds were seen in all. An adult ♂ was collected October 14.

95. Anthracothorax nigricollis nigricollis (Vieillot)

During October males and females of the Black-throated Hummingbird were common at flowers on the borders of forest near Rio Frio. The species was seen occasionally in scattered trees in a swamp near the town, as well as at banana flowers, and one was collected at heliconia flowers at about 2,500 feet elevation in the foothills on July 29. Although the male is distinctively colored, the black and blue of the lower surface do not show up well in the field, so that this sex is likely to be mistaken for the male of *Chalybura b. aeneicauda.* A ♂ molting into the adult plumage was shot at Rio Frio in November, but not preserved. It had narrow white lines still separating the blue and black areas of the ventral surface.

96. Saucerottia sophiae warscewiczi (Cabanis and Heine)

Saucerottia saucerottei warscewiczi Todd and Carriker.

Easily the commonest hummer of the region. It seems indiscriminately at home in the banana lots, bushy land, and forest of the plain, and ranges up to at least 3,000 feet in the foothills. It may be seen in numbers at almost any flower which attracts any hummingbirds. The species also feeds on insects, which are frequently secured from the surface of running water by a series of graceful hovering and dipping motions. The "song" consists of two whispering, peeping notes.

97. Amazilia tzacatl tzacatl (De la Llave)

Amazilia tzacatl is another abundant and pugnacious hummer of the banana lots, semi-open, and forest near Rio Frio. By an oversight no specimens were taken, but there can be no doubt of the identification.

98. Chalybura buffonii aeneicauda Lawrence

Carriker remarks that this species is always found low down in the forest, but I did not find it so, and it certainly does not approach the habits of *Phaethornis* in this respect. Its habits might more correctly be compared to those of the two preceding species, for none of these birds is specialized in behavior or choice of habitat.

99. Heliomaster longirostris longirostris (Vieillot)

Anthoscenus longirostris longirostris Todd and Carriker.

Mr. Bangs states that the coppery color of the rump, etc., referred to by Todd in the case of a Santa Marta specimen, is probably seasonal, for Brown's specimen lacks it. This species is readily known by its long, nearly straight bill and the white dash on its lower back. It is locally common near Rio Frio, where two specimens were collected on July 8. Both are males, one adult and one apparently nearly so. The birds are often seen in small groups or "families," and usually rest on conspicuous perches such as telephone wires or the exposed twigs of small trees. They prefer semi-open places. Birds were seen in the dry belt near Cienaga November 24, and at an elevation of about 500 feet in the hills above Rio Frio February 17.

100. Glaucis hirsuta affinis Lawrence

Only a few Lesser Hairy Hermits were seen. Most of them were in woods near water, but one or two were at flowers in a bushy field in company with other hummers. Smith's collectors found a nest in May attached to a wild plantain leaf, but the nests which I saw were all fastened to the lower surface of the leaflets of small, thorny palms growing in partial shade near water. One, discovered July 15, was in a mountain valley about 1,500 feet above Rio Frio. It contained two white eggs which measure 15 × 9.5 mm. Another nest, occupied by two young birds, was found near the Rio Frio River above the town in October, but had been destroyed by some unknown agency before November 11. A new nest was being constructed about ten yards from the site of the first at that time, however, and the remains of several old ones were hanging in the neighboring palms. All the nests seen were within six or eight feet of the ground. The bird builds a very coarse, open nest which departs from the usual standards of the family and reminds one a little of the architecture of swifts.

101. Phaethornis anthophilus anthophilus (Bourcier and Mulsant)

This spike-tailed hummingbird usually keeps out of sight in underbrush or dense thickets and only occasionally visits flowers in semi-open places. The species ranges to an elevation of at least 1,000 feet in the foothills above Rio Frio, and was seen at Aracataca March 23. It is a very shy bird, invariably seen near the ground, but is fairly common and may be located with a little practice by its call, which is sharper than that of the average hummer.

Family DENDROCOLAPTIDAE. Woodhewers

102. Dendrocincla meruloides lafresnayei Ridgway

Dendrocincla lafresnayei lafresnayei Todd and Carriker.

A single "family" of the thrush-like *Dendrocincla lafresnayei* was seen in heavy forest near Rio Frio, August 26. The birds uttered a sharp alarm note, kept near the ground, and were not shy. The only other individual seen was collected at the same place December 30.

103. Campylorhamphus trochilirostris venezuelensis (Chapman)

Two specimens only were seen and secured, an adult ♂ on September 2 and another on October 1. Both were in the heaviest lowland forest left near Rio Frio, and were climbing the trunks of large trees. No special use for the very elongate bill was noted. The only previous local record for the species seems to be for two birds taken at Valencia, south of the Sierra, by Carriker.

104. Lepidocolaptes souleyetii littoralis (Hartert and Goodson)

Thripobrotus albolineatus Todd and Carriker.

This, the smallest local woodhewer, is usually seen high up in forest trees, often on lateral limbs. It ranges to an elevation of at least 1,000 feet in the foothills near Rio Frio. It is fairly common.

105. Xiphorhynchus guttatus nanus (Lawrence)

Xiphorhynchus nanus nanus Todd and Carriker.

Lawrence's Woodhewer is a common forest species which is usually found climbing on the central trunk of a tree rather than on the limbs.

Its call is one of the characteristic forest sounds, and is a "Wick — wick — wick — wick — wick — wick," very loud and not fast.

106. Dendroplex picirostris picirostris Lafresnaye

The center of abundance of this pale-throated woodhewer is in the semi-arid area to the north of Rio Frio, but the species is common enough in low forest and semi-open near the town. It was seen at Aracataca March 3, at Cienaga March 9, and at Santa Marta January 7.

Family FURNARIIDAE. Ovenbirds

107. Synallaxis albescens albigularis Sclater

Perhaps half a dozen *Synallaxis* were seen in all. Two were near Rio Frio, where an adult ♂ was obtained September 30, and the rest were at Cienaga on February 27 and March 9. All were in bushes or low thickets in dry, overgrown pasture land, but the Cienaga birds were within a few yards of the swamp.

Certhiaxis cinnamomeus fuscifrons (von Madarasz)

Leptoxyura cinnamomea fuscifrons Todd and Carriker.

Abundant in the rank vegetation of the swamps at Cienaga and Aracataca, and seen once at Patuca Farm. It occurs also in the mangroves along the Cienaga Grande at Sevillano. For some inexplicable reason it was never seen at Rio Frio, although the swamps there seem in every way suitable. The bird has several scolding notes, as well as a long rattle which is a characteristic marsh sound. The nest is a domed structure of thorny twigs with a long entrance tunnel. The one I saw was near Cienaga, placed on a low tussock surrounded by flood water, October 6, and was occupied.

108. Xenops minutus neglectus Todd

Xenops genibarbis neglectus Todd and Carriker.

The *Xenops* is found in the same sort of place as the little piculet (*Picumnus*) and is about equally common and tame. It is usually seen climbing silently about in the vines and bushes of the forest or second-growth.

109. Furnarius leucopus longirostris von Pelzeln

Furnarius leucopus exilis Todd and Carriker.

The common local ovenbird, which looks like a short-tailed, brown thrush, is abundant in semi-open country north of Rio Frio, but is less often encountered near the town. It is often seen in pairs on the ground or on dirt roads, near water. The birds are very noisy and sometimes scold in a duet much like that of the wren genus *Helcodytes*, although they do not keep time as well as the latter.

Family FORMICARIIDAE. Ant-birds

110. Myrmeciza longipes panamensis Ridgway

A species which is found on the ground in forest undergrowth, often in pairs, and which is very tame. The characteristic call is a slightly descending series of non-liquid notes, given so fast that it is almost a rattle, but the species has also a harsh, scolding chatter. The bird is abundant near Rio Frio.

111. Cercomacra nigricans Sclater

Whenever a group of birds gathers to mob a hawk or an owl, *Cercomacra nigricans* is almost sure to be present, especially if the action takes place in brushy forest. At other times the birds are found in pairs or "families," sometimes in tall trees and sometimes in the underbrush, but never walking about on the ground like the *Myrmeciza*. Two or more birds sometimes break out together into a series of harsh chatters, a habit which, as in the case of *Furnarius leucopus longirostris*, may be compared to that of the *Heleodytes* wrens, and which may be the first step in the development of an antiphonal song. An immature ♂ in gray plumage was collected October 28 and another was seen a few days later. The first was accompanied by an adult.

112. Neorhopias grisea intermedia (Cabanis)

Microrhopias intermedia Todd and Carriker.

Little, gray and black *Neorhopias* are common in brush land near Rio Frio. They are usually found in pairs low down in the bushes, and are very tame. They resemble warblers of the genus *Dendroica* both in appearance and in behavior.

113. Thamnophilus nigriceps Sclater

A fairly common bird in forest and overgrown land near Rio Frio. It is usually seen in pairs low down, but not on the ground, and seems to be less active than the other local ant-birds.

114. Thamnophilus doliatus nigricristatus Lawrence

Thamnophilus radiatus nigricristatus Todd and Carriker.

The Black-crested Antshrike is a bird which lives in the very densest thickets, ranging from the lowlands up to at least 2,000 feet in the Rio Frio foothills. It is common but not easy to find until one learns its call, which is a series of progressively lower whistled notes ending in a distinct squawk, and which I heard given only by the male.

115. Sakesphorus melanonotus (Sclater)

A species which, near Rio Frio, is probably confined to the foothills, for the only pair seen was secured there. The ♂ was shot December 23, perhaps 200 feet above sea level; the ♀ was shot September 15, about 1,000 feet up. Both were in bushes in open forest.

116. Sakesphorus canadensis pulchellus (Cabanis and Heine)

Sakesphorus pulchellus Todd and Carriker.

The only specimen secured, an adult ♂, was shot in a thicket at Aracataca, July 1. The species was seen occasionally in bushy places at Rio Frio and once in arid scrub at Sevillano, but was nowhere common. Like its relatives, it is found in the shrubs rather than on the ground.

Family COTINGIDAE. Cotingas

117. Erator inquisitor albitorques (Du Bus)

The *Erator* is a scarce bird near Rio Frio. It occurs singly or in pairs, usually well up in the trees on the edge of forest.

118. Pachyrhamphus polychropterus cinereiventris Sclater

During the fall this cotinga was noted near Rio Frio as "scarce, solitary, and apparently silent, in forest, usually about half way up in the trees." In November, however, a "family" group was seen in forest south of the town. The birds were located by their low alarm notes.

119. Pachyrhamphus cinnamomeus magdalenae Chapman

A single ♂ was collected in a forest tree near Rio Frio on December 30, but no other individuals were ever seen near the town. Several brown *Pachyrhamphus* were noted in open forest near Aracataca March 3. They may, however, have been *P. rufus* (Boddaert), for to judge from Todd's remarks (in The Birds of the Santa Marta Region) females of *rufus* would scarcely be distinguishable in the field from *P. cinnamomeus magdalenae.*

120. Attila spadiceus parvirostris Allen

Attlla parvirostris Todd and Carriker.

An *Attila* was secured at an elevation of about 1,000 feet in the foothills above Rio Frio February 17. It was in forest in a brook valley. Two were seen February 24 in a similar place beside the Rio Frio River at an altitude of 500 feet. The birds were behaving like flycatchers. The specimen secured is an adult ♂ in wholly rufescent phase, with only the chin, lower belly, and under tail coverts pale, and the lower rump and upper tail coverts yellow. In referring this specimen to *A. parvirostris* it is being assumed that *A. rufipectus* Allen, described from the Santa Marta region, is based upon an individual color variation of no taxonomic significance.

Family PIPRIDAE. Manakins

121. Chiroxiphia lanceolata (Wagler)

A common bird in forest underbrush, where it often occurs in small flocks. The flight is much less noisy than that of the *Manacus.* The call is a clear, one- or two-syllabled whistle, and there are also two types of rather harsh, unmusical alarm notes, with a rattling or vibrating quality.

122. Manacus manacus abditivus Bangs

This little, white-bearded manakin is another species characteristic of forest underbrush. Its wings make a purring sound in flight, but the bird does not move as fast as the sound would suggest. The call notes are a loud rattle and a cracking or snapping sound.

Family TYRANNIDAE. Flycatchers

Muscivora tyrannus (Linné)

The first *Muscivora* were encountered September 15 at Donjaca, where moderate flocks were observed flying south along the coast.

This probably indicated the arrival of a migrant population, although some individuals of this species are said to be resident in the Santa Marta region. Later in the season the flocks disappeared, but single birds and small groups were common in the semi-arid area at Sevillano and Cienaga during the winter. The species was not seen at Rio Frio but was noted March 3 at Aracataca. It seemed to be rare everywhere in the the more humid parts of the plain, however.

123. Tyrannus curvirostris curvirostris (Hermann)

Tyrannus curvirostris is a West Indian kingbird which was seen from time to time near Rio Frio during the dry season or winter. One, sex not determined, was collected near the town, December 3.

124. Tyrannus melancholicus chloronotus Berlepsch

Lichtenstein's Kingbird looks rather like a large *Myiarchus* in the field. It is a common and conspicuous resident of scattered trees and open woodland, and ranges over the entire plain, including both the semi-arid and humid areas, and up to at least 1,500 feet in the mountains. The song is an ascending series of trilled notes, totally unlike anything which I have heard from the other kingbirds.

125. Tyrannus tyrannus (Linné)

Kingbirds which seemed to be of this species were seen in large flocks flying south along the coast at Donjaca, September 15. Later in the year the flocks move on or break up, but some, at least, of the birds remain, for small groups of half a dozen or so were seen from time to time at Rio Frio. From one of these, an adult ♂ was secured on September 16.

126. Pitangus sulphuratus rufipennis (Lafresnaye)

The common *Pitangus* is one of the dominant birds of the coastal plain. It is found in open and semi-open country, and is noisy and very conspicuous. In habits it is a typical flycatcher.

127. Megarynchus pitangua pitangua (Linné)

The Boat-billed Flycatcher is a fairly common, noisy, and conspicuous bird in semi-open places near Rio Frio.

128. Myiarchus tuberculifer tuberculifer (d'Orbigny and Lafresnaye)

Its small size distinguishes *Myiarchus tuberculifer* from the other local representatives of the genus. Only a few individuals were seen. They were all in a forested brook valley in the edge of the Rio Frio foothills, where an adult ♀ was secured March 15.

129. Myiarchus ferox panamensis Lawrence

130. Myiarchus tyrannulus tyrannulus (Müller)

131. Myiarchus crinitus crinitus (Linné)

The larger species of *Myiarchus* are difficult to distinguish in the field, especially as they all have the same habits. They are found in open woodland and scattered trees and together are very abundant. *M. f. panamensis* is apparently the common bird near Rio Frio, but *M. t. tyrannulus* was shot there August 12, and a specimen of *M. c. crinitus*, which is, of course, our Crested Flycatcher and a winter resident, was secured November 11.

132. Sayornis nigricans latirostris (Cabanis and Heine)

Sayornis latirostris fumigatus Todd and Carriker.

The local Phoebe is common wherever there is swiftly running water, which is chiefly in the foothills of the Sierra Nevada. Its behavior is very much like that of our New England Phoebe. It continues to inhabit the beds of the *quebradas* or small brooks during the dry season, when the flow almost completely stops, provided there are open pools left here and there.

133. Empidonax traillii traillii (Audubon)

Empidonax traillii brewsteri Todd and Carriker (?).

Traill's Flycatcher appeared to me to be common during the winter season in open forest, but I may have mistaken other species for it in some cases. Mr. Bangs says that he believes the adult (sex not determined) collected September 30 at Rio Frio belongs to the eastern race *traillii*. He agrees with Todd, however, that the eastern and western forms are not surely distinguishable in worn plumage.

134. Cnemotriccus fuscatus cabanisi (Leotaud)

Empidochanes fuscatus cabanisi Todd and Carriker.

A small flycatcher with rufous wing bars, which was secured in forest near Rio Frio September 4, proves to be a ♀ of this species.

135. Pipromorpha oleaginea parca (Bangs)

Bangs' *Pipromorpha* is fairly common in forest near Rio Frio. An adult (♂ ?) which was shot November 25 had a curious, tuber-like growth on the chin, and another individual with a similar deformity was seen a few days later. The growth on the first bird was unfeathered, trilobed, and with a minute puncture in the apex of each lobe. It dried up and nearly disappeared in the skin.

136. Myiozetetes similis columbianus Cabanis and Heine

"Family" groups of the common *Myiozetetes* are often encountered in fringes of woodland or scattered trees near or over swamps and rivers. The birds have a noisy call with a peculiar, squealing quality. A nest with young birds calling in it was noted March 17 in a cleft in a low cliff on the river bank near Rio Frio. Another nest was seen from a distance in a bush in the same sort of locality in early April. It was made of grass or similar stuff and was domed over.

137. Elaenia gaimardii macilvainii Lawrence

A single specimen, an adult ♀, was collected in heavy forest near Rio Frio on March 7.

138. Elaenia flavogaster flavogaster (Thunberg)

One or more small flocks inhabit the fresh swamps near Rio Frio, where they are usually to be found in the scattered trees above the cat-tails.

Sublegatus modestus glaber Sclater and Salvin

Sublegatus glaber Todd and Carriker.

A species which resembles a very small *Myiarchus* in the field, and which was seen only in the dry scrub at Sevillano. An adult ♂ was secured there January 20.

139. Inezia subflava intermedia Cory

Inezia caudata intermedia Todd and Carriker.

140. Tolmomyias sulphurescens exortivus (Bangs)

141. Tolmomyias flaviventris aurulentus (Todd)

These three flycatchers are all small, plain birds which were secured in woodland near Rio Frio.

142. Atalotriccus pilaris pilaris (Cabanis)

So small and inconspicuously colored a bird as the Pigmy Flycatcher would easily be overlooked if it were not common and did not have an unexpectedly loud chipping note. It is usually found in "families," and stays near the ground in open forest and bushy places.

143. Todirostrum sylvia superciliare Lawrence

Only one individual of this minute bird was seen. It was collected in forest underbrush near Rio Frio on February 23.

144. Todirostrum nigriceps Sclater

Tiny, black-capped Tody Flycatchers are not rare in the forest and semi-open near Rio Frio. They may easily be located by their calls, which are successions of loud chipping notes entirely out of proportion to the size of the birds. The species is sometimes seen, or more often heard, high up in the tree tops, but is found in bushes and undergrowth as well.

145. Todirostrum cinereum cinereum (Linné)

This species seems to be most at home in the swamp shrubbery at Cienaga and in the mangroves at Sevillano, but an individual was shot at Rio Frio on June 12. This was, I think, the only one seen there. It was climbing about in the twigs of a small tree in a pasture, and uttering a fine, insect-like peeping note at intervals. A very young bird accompanied by two adults was seen in a tree over a cat-tail swamp at Cienaga March 9.

Machetornis rixosa flavigularis Todd

M. r. flavigularis is a common inhabitant of the semi-arid area, in which it ranges as far south as Sevillano. Its range apparently does not include Rio Frio, however. It prefers fairly open places, and has the curious habit, for a flycatcher, of feeding largely upon the ground.

Arundinicola leucocephala (Linné)

146. Fluvicola pica (Boddaert)

These two small flycatchers have mutually similar habits and are almost exclusively swamp dwellers, being rarely found more than a few yards from standing water. Occasionally, however, they are to be seen near rivers (Rio Fundacion, March 2), and in Trinidad I have

seen *F. pica* hawking from low perches in a dry field. Both species always stay near the ground. In the Santa Marta region the *Fluvicola* is abundant and the *Arundinicola* scarce. Both occur in the mangroves at Sevillano and the marshes at Cienaga, and the former is common at Aracataca. Neither was ever secured at Rio Frio, but the *Fluvicola* was seen there once or twice. Two nests of this bird were found at Cienaga in November. They were placed in cat-tails about a yard above the water and were small, domed structures of grassy material, without elongate tunnel entrances.

Both *F. pica* and *A. leucocephala* are unmistakable among the local flycatchers, for the former is marked by large patches of black and white, and the latter is black with a white head.

Family MIMIDAE. Mockingbirds

Mimus gilvus columbianus Cabanis

The local *Mimus* is one of the few species which is abundant in the semi-arid area and which ranges south to within about three miles of Rio Frio, but which apparently never straggles to the town. It seems to be a perfectly typical mockingbird in its song and habits.

Dumetella carolinensis (Linné)

A single adult ♀ of our northern Catbird was secured as it was skulking in bushes beside one of the fresh swamps at Cienaga, March 23, 1929. This seems to be the first record for South America.

147. Donacobius atricapillus brachypterus von Madarasz

This curious bird is characteristic of the fresh swamps near Aracataca and Rio Frio, but is scarce in those at Cienaga. It spends most of its time low down in the dense aquatic vegetation, where it reveals its presence by a variety of noisy calls. The song is a harsh but beautifully timed antiphonal affair, which I have watched repeatedly, for the birds are tame and often leave cover to sing in pairs from exposed perches. In its habits *Donacobius* seemed to me much more like a wren than a mockingbird, and it shares the habit of antiphonal singing with at least one species of *Heleodytes*.

Family TURDIDAE. Thrushes

148. Turdus grayi incomptus (Bangs)

In the Santa Marta region this plainly colored thrush more or less takes the place of our Robin, although it is a more retiring bird and

stays more in the trees. It is also more fond of open woodland than the Robin is. The song is very Robin-like, and, similarly, is often heard in the early morning and evening.

149. Hylocichla minima aliciae (Baird) ?

Migrant thrushes, which were probably the present species, were fairly common in low forest south of Rio Frio during the fall, but not a single bird was seen during the months from December to April, inclusive. This probably indicates some sort of local migration in search of food. Unfortunately no specimens were collected.

Catharus melpomene aurantiirostris (Hartlaub)

Several were seen and one secured in forest undergrowth well up on the "Cerro La Aguja," about 2,000 feet above Rio Frio, June 17.

Family SYLVIIDAE. Gnatcatchers, etc.

150. Ramphocaenus rufiventris sanctae-marthae Sclater

The only two of these long-billed, wren-like birds which were surely identified were collected in underbrush and low forest near Rio Frio on September 19 and March 15. Both are adult males.

151. Polioptila bilineata bilineata (Bonaparte)

Several gnatcatchers, from among which an adult ♂ was secured, were seen in the tops of tall trees in open forest southeast of Rio Frio, October 12. The song or call was a "Chip — chip — chip . . ." of about nine syllables, and was as slight and unassuming as the size of the bird would suggest. Two individuals were noted near the same place on February 23.

Family TROGLODYTIDAE. Wrens

152. Thryophilus leucotis leucotis (Lafresnaye)

T. leucotis is a common species in forest and second-growth along the Rio Frio River. Its song is often delivered from well up in bushes or low trees, and is a repetition of several gulping syllables, somewhat reminiscent of the song of the Maryland Yellow-throat (*Geothlypis trichas*). This wren seems to be less noisy than the others.

153. Thryophilus rufalbus minlosi Berlepsch

The bird is at once a great scold and a magnificent singer, with a very sweet, clear song of several loud, deliberate notes. The song is usually delivered from a perch a few yards above the ground in some dense thicket. The species is common in second-growth and forest from Rio Frio up to at least 1,000 feet in the hills near the town.

154. Troglodytes musculus atopus Oberholser

The Santa Marta House Wren is a common bird which seemed to me to behave exactly like its New England relative and to live in the same sort of places, except that it was abundant in the cactus and acacia scrub of the semi-arid area as well as in the more humid country.

155. Pheugopedius fasciatoventris fasciatoventris (Lafresnaye)

In my experience the Band-bellied Wren occurs, not very commonly, in scrubby forest. It usually goes in small, noisy "families" *not* near the ground, but twenty or thirty feet up, in bushes and low trees. It is a great chatterer. These notes differ considerably from those given by Carriker, a circumstance which is probably due to the scarcity of the bird in question, and to the comparatively few times it was observed. An adult ♂ was secured near Rio Frio August 5.

Heleodytes pardus (Bonaparte)

Heleodytes nuchalis Todd and Carriker.

Heleodytes pardus is a common bird in the dry scrub near Cienaga, where it seems to replace *H. curvirostris*. Todd and Carriker record it from the humid area below Aracataca, but none was seen at Rio Frio. The bird thus has the same curious local range (including the very driest and very wettest parts of the plain) as *Crotophaga major*, but it apparently does not migrate as the latter does. A nest at Cienaga which was claimed by this wren consisted of a loose mass of grassy material, domed and with an entrance tunnel, and placed in the top of a low thorn tree. The single specimen collected is an adult ♀ from Cienaga, October 6.

156. Heleodytes curvirostris (Ridgway)

This spotted wren is common enough in forest and second-growth near Rio Frio. It occurs both in the underbrush and in tall trees. The birds go in "family" groups which break out in series of harsh chatters

as if at a signal, but I did not hear them sing antiphonally. Perhaps the habit of chattering in chorus may have led to the antiphonal singing in this genus. The species was seen at Patuca Farm in January. The white background of the belly of *H. pardus* and the buffy one of *H. curvirostris* are easily distinguishable in the field.

157. Heleodytes minor albicilius (Bonaparte)

Few birds are more in evidence or more pleasing to the visitor in the Santa Marta region than this big wren, which is characteristic of all sorts of semi-open country and forest fringes in both the semi-arid and humid parts of the coastal plain. It is an aggressive and "successful" species, very common near houses, and occasionally destructive to mangoes and *avocates*. It feeds both on the ground and in trees. It is not at all shy, and is one of the few species which had been bold and clever enough to learn to glean insects under the electric lights early in the morning. The birds have a harsh but well timed antiphonal song which they sing in pairs and which is often heard, and they round out their vocabularies with a variety of scolding notes and family chatterings. The nests are large, domed structures of loose, grassy material, and were seen in the outer branches of large, isolated trees in March.

Family CORVIDAE. Jays, etc.

158. Cyanocorax affinis affinis Pelzeln

Abundant in forest and semi-open near Rio Frio and up to at least 5,000 feet in the neighboring mountains. The species feeds in trees in small flocks. It is often seen in company with *Ostinops decumanus melanterus* Todd, which it rivals in its variety of calls. One of the commonest of the latter gives it its local name of "Chow-chow." The Colombians consider the bird good eating.

Family VIREONIDAE. Vireos

159. Cyclarhis flavipectus canticus Bangs

C. f. canticus is an aberrant vireo with a distinctive, stout bill. It is common near Rio Frio in open forest and second-growth, and is usually found about halfway up in the trees. It is much less active than the typical members of the family. The song is loud and clear, much like that of the Red-eyed Vireo, but a little more deliberate and with the separate "bursts" of song a little longer.

160. Pachysylvia aurantiifrons aurantiifrons (Lawrence)

161. Pachysylvia flavipes flavipes (Lafresnaye)

These two inconspicuous vireos were collected in woodland near Rio Frio on November 11 and October 7 respectively.

162. Vireo flavoviridis flavoviridis (Cassin)

Vireosylva flavoviridis flavoviridis Todd and Carriker.

A species which feeds in small bands in the tops of certain low forest trees. It is rather shy but not rare at the right season. I noted it only during the winter, and secured a specimen (sex not determined) on October 11, at Rio Frio.

Family HIRUNDINIDAE. Swallows

Iridoprocne albiventer (Boddaert)

I. albiventer is frequently encountered, a few birds at a time, along the Cienaga Grande near Sevillano and in the Cienaga fresh swamps. A few were seen also over the Fundacion River, March 2. One specimen was collected, an adult ♂ taken at Sevillano January 20.

Hirundo rustica erythrogaster Boddaert

During the fall Barn Swallows were abundant near the fresh swamps of Cienaga and along the Cienaga Grande at Sevillano. Flocks of twenty or thirty birds were commonly seen. The species was *not* seen at Sevillano on January 20, however, and was not met with again anywhere until April 13 at Cienaga. This, combined with the past records given by Todd and Carriker, seems to indicate that the species is only a migrant, not a winter resident, in the Santa Marta region. A single specimen, an adult ♂, was collected at Sevillano on October 20.

163. Stelgidopteryx ruficollis aequalis Bangs

Swallows of this species are fairly common near Rio Frio, where they are usually seen in pairs, threes, or fours hawking in open places. Freshly cut stump land is a favorite feeding ground.

164. Phaeoprogne tapera tapera (Linné)

Several Tree Martins were seen and one, an adult ♀, secured over the Fundacion River near Aracataca, March 2. Two were seen at

close range on the railroad bridge over the Rio Frio River in early April, and others which appeared to be of the same species were occasionally noted near the town. Santa Marta birds belong, of course, to the unspotted northern race. There seem to be no previous records for the region.

Family MNIOTILTIDAE. Wood-warblers

165. Basileuterus delattrii mesochrysus Sclater

I saw Sclater's Warbler only along the Quebrada Mateo in the edge of the foothills near Rio Frio. It was found in the underbrush of the deciduous forest on the brook banks, usually in pairs. The birds often revealed their presence by their fairly loud scolding notes.

166. Setophaga ruticilla (Linné)

Redstarts are abundant near Rio Frio during the winter. They behave as they do in the North, and frequent as far as possible the same sort of habitat. An adult ♂ was secured at Rio Frio on October 11.

167. Seiurus noveboracensis noveboracensis (Gmelin)

The Northern Water Thrush is a common winter resident which is to be found feeding on the ground along the banks of swiftly flowing streams, usually in woodland. It is very shy and flies long distances when flushed. This is probably the species which occurs commonly in the mangrove swamps at Sevillano, but since my only specimen, an adult ♂, is from Rio Frio, October 1, I cannot be sure.

168. Seiurus motacilla (Vieillot)

A single adult ♂ Louisiana Water Thrush was collected from a tree on the edge of dry woods near Rio Frio on December 4.

169. Oporornis philadelphia (Wilson)

No specimens of this, the Mourning Warbler of the North, were preserved, but the species has been identified from the description of an adult ♂ shot near Rio Frio on November 29. Other birds were seen occasionally during the winter. They were usually near the ground in low, bushy forest.

170. Oporornis agilis (Wilson)

A bird which was almost certainly an adult ♂ Connecticut Warbler was shot in a dry thicket near Rio Frio in October. The specimen was

hopelessly ruined during skinning and, unfortunately, was discarded. In view of the rarity of the species in South America this record must be considered doubtful, but is included here to complete the list of birds noted at Rio Frio.

171. Oporornis formosus (Wilson)

Kentucky Warblers are scarce near Rio Frio, but a ♂ was secured there on October 28. They occur, of course, only during the winter, and are usually found near the ground in low, tangled forest.

172. Dendroica striata (Forster)

Dendroica striata has a peculiar local distribution. It was found in numbers in weeds and low bushes in a dry clearing southeast of Rio Frio in October (one secured October 11), and a few birds were seen in open woodland near by. During the same month it was present also in the mangroves at Sevillano (one collected October 13), where it was temporarily the commonest perching bird with the exception of *Protonotaria citrea*. It was not seen in any other place, and disappeared from the entire region during December, January, February, and March.

173. Dendroica aestiva aestiva (Gmelin)

Our Yellow Warbler is abundant during the winter season in the same sort of places that it favors in the North.

Dendroica coronata coronata (Linné)

A (♀ ?) Myrtle Warbler was collected in dry scrub at Cienaga on March 23, 1929. Two individuals had been seen in the edge of a cat-tail swamp near the same place a few days before. There appear to be no previous South American records for the species. The bird collected was very fat.

174. Compsothlypis pitiayumi elegans Todd

A forest dweller with habits and song something like those of the Parula Warbler, *Compsothlypis americana*. It is a rare species on the plain near Rio Frio, but is fairly common in the edge of the foothills a mile or so to the east.

Ateleodacnis bicolor (Vieillot)

I saw this resident warbler only in October, in the mangroves near Sevillano. Carriker, too, found the species only in the mangroves along the Cienaga Grande.

175. Ateleodacnis leucogenys leucogenys (Lafresnaye)

Ateleodacnis leucogenys Todd and Carriker.

The little, bluish *Ateleodacnis* is common in open forest in the neighborhood of Rio Frio. It usually feeds about halfway up in the trees, but sometimes descends to the tops of tall weeds in new clearings.

176. Vermivora peregrina (Wilson)

A single ♂ was collected November 11 in woodland at Rio Frio.

177. Protonotaria citrea (Boddaert)

The Prothonotary Warbler swarms during the winter in the mangroves at Sevillano and in the fresh swamps at Cienaga. It was seen also in bushes on the sea beach at Donjaca September 15, and along the Rio Frio River in the edge of the foothills, where it was especially common in February. The birds usually occur near water, but numbers were noted again and again in yellow-flowering, acacia-like trees on the border of stump land and dry forest, far from water. The only specimen collected is an adult ♂ from Donjaca September 15.

178. Mniotilta varia (Linné)

Near Rio Frio Black and White Warblers are scarce winter residents. They are usually met with singly in open forest, sometimes high in the trees and sometimes low down. On February 17 one was seen at an elevation of about a thousand feet in the foothills. One specimen was collected, an adult ♂, from Rio Frio on September 30.

Family COEREBIDAE. Honey-creepers

179. Coereba luteola luteola (Cabanis)

Coereba luteola is abundant in every type of habitat about Rio Frio except in heavy forest and grassy fields, and it sometimes enters these. The song is a little, vibrant, insect-like affair which varies greatly in different individuals, and which is sung continually. The birds feed like warblers (*Dendroica*) in "families" in bushes and low trees. They are very tame. The nests are neat, domed structures of grassy and fibrous material, often placed near the ground in bushes or fences, and very frequently built into bunches of bananas. It is unlikely, however, that the birds usually have time to raise a brood before the bananas are cut. Nests were seen in the spring and in November, and a bird was flushed

from an empty nest in a bush of the terrible "Pringamósa" nettle (*Jatropha urens* L.) early in January. These honey-creepers were very common at flowers, with hummingbirds, in October and November.

180. Dacnis coerebicolor napaea Bangs

The adult males are black and bright blue, the females nearly plain green. Only four birds were seen in all, two in a giant forest tree near Rio Frio, October 12 and February 23, and two in a low tree in open forest, September 9.

181. Cyanerpes cyaneus eximius (Cabanis)

Cyanerpes cyaneus Todd and Carriker.

A single specimen was secured December 25 in a tree in open forest at Rio Frio. It is a ♂ just starting to molt into the gorgeous adult plumage. No others of the species were seen.

Family ICTERIDAE. Orioles, etc.

Leistes militaris militaris (Linné)

Leistes militaris Todd and Carriker.

Red-breasted Blackbirds were seen only in an area of short grass and scattered bushes on the edge of the Cienaga fresh swamps. A flock of fifteen or twenty individuals, from which a pair was collected, was discovered there on November 10. It included at least three adult males, one of which was singing a low, reedy song something like that of the Red-winged Blackbird (*Agelaius phoeniceus*) but not so loud and clear. On November 17 there were at least five adult males and many dull colored birds at the same place, and a small flock was seen again November 22, while a single adult ♂ was noted from the train window March 26.

182. Agelaius icterocephalus icterocephalus (Linné)

Yellow-headed Blackbirds are abundant in the fresh swamps at Cienaga and Aracataca, but only one or two were seen at Rio Frio. They do not seem to be associated with any special type of marsh vegetation, provided only the latter is rank and extensive. One specimen was taken, an adult ♂ from Cienaga, October 6.

183. Icterus galbula (Linné)

Although there have been very few previous records for the Baltimore Oriole from the Santa Marta region, the species is a fairly common winter resident. It is rather easily overlooked, however, for it is silent and is often found high up in the trees. It was recorded on the following occasions: about six, of which three were collected, seen in October and November near Rio Frio, the first bird being secured October 13. One ♂ and probably one ♀ noted feeding in company with *I. auricapillus* in forest near Rio Frio in early December. An adult ♂ seen from the train at Donjaca in late November. A molting ♂ collected February 14 in open woods near Rio Frio. An adult ♂ seen flying near Rio Frio February 23, and one seen at Aracataca on March 3. Three or four adult males seen near Rio Frio on March 7, and one March 10.

184. Icterus mesomelas carrikeri Todd

Carriker's Oriole is fairly common at Rio Frio, and several were noted near Aracataca on March 3, but the species was absent in many apparently suitable localities. The birds are usually seen in small groups in overgrown, swampy land, but they occasionally invade shade trees about towns. They are noisy scolders, but have a fine, typical oriole song too.

Two nests were found, both shallow structures for an oriole and placed only three or four yards above the ground. One was hung in a small tree on the edge of a Rio Frio swamp and the other in a small ornamental palm in the "patio" of our house at Rio Frio. The leaf margins of the palm raveled out into fibers which the orioles utilized both to attach and to construct their nest. The first nest was occupied in September; the young left the second just at the end of November.

185. Icterus nigrogularis nigrogularis (Hahn)

By far the most abundant oriole at Rio Frio. It is a conspicuous inhabitant of all sorts of semi-open places. The song and scolding notes are such as are usually found in the genus. This bird is probably responsible for the deep nests, like those of the Baltimore Oriole, which are frequently seen at the ends of the branches of tall trees.

186. Icterus auricapillus Cassin

A rather scarce and retiring bird as compared with the other resident species of the genus. It was, however, encountered near Rio Frio on

several occasions, sometimes in heavy forest and sometimes in rather open country.

Icterus spurius (Linné)

A ♂ in dull plumage was secured February 27 in a grove of trees near Cienaga and an adult ♂ was taken near the Fundacion River west of Aracataca on March 2. On the afternoon of the same day a flock of at least eight birds, including three adult males, was observed in an overgrown fence row in the United Fruit Company's Aracataca "Prado."

Cassidix mexicanus assimilis (Sclater) [1]

Megaquiscalus major assimilis Todd and Carriker.

The Great-tailed Grackle is a common bird in the mangroves along the Cienaga Grande and in the open country around the fresh swamps at Cienaga, and is especially common in the outskirts of the towns of Cienaga and Santa Marta. It usually feeds on the ground in small flocks. The song is a loud, variable affair of a few wiry and not very musical notes.

Molothrus bonariensis cabanisii Cassin

A flock of about ten Cowbirds was discovered in the cactus scrub at Sevillano October 13. The birds were rather shy, but several could easily have been secured in addition to the single one (sex not determined) taken. A flock of four or more individuals was seen in bushes on the United Fruit Company's "Prado" in Santa Marta on January 7, when one was heard to sing a few squeaky but musical notes. My only other record is of a few seen about cows in a pasture west of Aracataca on March 2.

187. Psomocolax oryzivorus violeus (Bangs) [2]

Cassidix oryzivora violea Todd and Carriker.

The Rice Grackle is only occasionally found near Rio Frio. It usually goes in small flocks and was once noted with a flock of *Ostinops,* with which it sometimes roosts in the bamboos. It is typically a bird of the drier, open country, usually seen in scattered trees. On January 18, a flock of fifteen or twenty birds was observed in which one individual stood out uniquely on account of its large size. It was collected and

[1] *Cf.* J. L. Peters, Proc. Biol. Soc. Washington, **42**, 1929, p. 121.
[2] *Cf.* ibid.

proved to be an adult ♂, but whether the observation indicates that males are disproportionately scarce I do not know.

188. Ostinops decumanus melanterus Todd

This *Ostinops* is an abundant and unmistakable species near Rio Frio, although nesting trees were seen only in the edge of the foothills. The nest is, of course, a very deep bag, of which several are built in a single tree. The birds feed in flocks in forest, semi-open, and even banana lots, often in company with the big *Cyanocorax* jay, and may sometimes be seen feeding on the ground. They have a great variety of notes, one of the most characteristic of which resembles the creaking of bamboo or the strident sound produced by the rubbing of two branches in a wind. Scores and sometimes hundreds of these huge, yellow-tailed orioles roosted regularly in a dense clump of bamboo just opposite our house. They approached the roost singly or in flocks (between 5.08 and 5.30 when timed on December 25) and were at first very noisy, but they never bothered us much after dark. They are called "Oropéndulo" locally.

Family THRAUPIDAE. Tanagers

189. Eucometis cristata cristata (Du Bus)

The Gray-crested Tanager is strictly confined to the underbrush of forest, where it is usually found in "family" groups. Like most of the other species of similar habits, it is scarce near Rio Frio, for there is comparatively little heavy forest left there. The bird has a sharp, loud alarm note.

190. Ramphocelus dimidiatus dimidiatus Lafresnaye

Bushy fields, abandoned areas of brush, and sometimes low, open forest are all inhabited by the striking "Sángre Tóro." The birds are usually found in "families" in bushes or low trees, are active and hard to approach, and have a sharp alarm note which they give continually. Although the species is common, I did not hear it sing.

191. Piranga rubra rubra (Linné)

The Summer Tanager was first seen November 11, when an adult ♂ was collected near Rio Frio. It was fairly common in open forest and scattered trees near the town during the rest of the winter, or at least until I left the region in April.

192. Thraupis palmarum atripennis Todd

A single Palm Tanager was collected near Rio Frio in low forest in company with *Dacnis coerebicolor napaea* on September 9, and one was seen in a grove of Wine Palms at Aracataca on March 3.

193. Thraupis episcopus cana (Swainson)

Small flocks of the Blue Tanager are abundant in semi-open localities and open forest near Rio Frio, and are commonly encountered, too, in the shade trees of Santa Marta, so that the bird is one of the species which the visitor is sure to see. The flocks sometimes descend to the ground to feed about rotting bananas, but they are more at home in the trees and are especially partial to the "Guarúmo" or *Cecropia*.

194. Tanagra crassirostris (Sclater)

T. crassirostris occurs in largish flocks, sometimes of two or three dozen birds, in low, scrubby woodland. It has a good warbled or trilled song, more erratic and more broken than the canary's. It is a favorite local cage bird and is trapped by boys, who locate the tree in which a flock is feeding and hang out traps containing live decoys. The species is probably also taken with bird lime, for the Colombians get a very good lime from the gum of a tree.

195. Tanagra trinitatis (Strickland)

This little tanager is usually seen in pairs or small flocks in the trees in bushy forest. It is mueh less common than *T. crassirostris*. During the fall a flock of probably more than a dozen birds roosted regularly in the leafy lower branches of a large, isolated tree in a Rio Frio pasture.

Family FRINGILLIDAE. Finches

196. Saltator striatipictus striatipictus Lafresnaye

All previous local records for *S. striatipictus* are from the northern foothills of the San Lorenzo, but the bird proves to be a common inhabitant of open forest and second-growth at Rio Frio. The song is much like that of *S. olivascens plumbeus*. The present species is more retiring than the latter and is more commonly found in woodland, but the habitats of the two overlap widely. Both are tree feeders, rarely or never seen on the ground. A single adult ♂ of *striatipictus* was collected, September 16, in the edge of the Rio Frio foothills.

197. SALTATOR OLIVASCENS PLUMBEUS Bonaparte

Common in open forest, bushy abandoned land, shade trees, etc., at Rio Frio and Santa Marta. The species has a short, sweet, warbled song, rather deliberately given.

198. HEDYMELES LUDOVICIANUS (Linné)

Rose-breasted Grosbeaks were first seen near Rio Frio November 11, when one (sex not determined) was secured, and were met with thereafter from time to time until March 7. They frequent open woodland and scattered trees very much as they do in the North. I did not hear them sing.

199. CYANOCOMPSA CYANOIDES CYANOIDES (Lafresnaye)

Only two individuals of the Panama Blue Grosbeak were seen. A ♂ was secured in the underbrush of heavy forest near Rio Frio September 2, and a ♀ was taken October 14 in similar cover. The ♂ sang a very sweet, warbled song, so low that it was scarcely audible fifteen yards away. The ♀ advertised its presence by chirping loudly.

200. SPOROPHILA GUTTURALIS (Lichtenstein)

Common in small flocks, usually in bushy abandoned land. The birds feed on the ground but are often seen resting in trees.

201. SPOROPHILA MINUTA MINUTA (Linné)

This small finch is abundant in grassy fields near Rio Frio. In February, March, and April the birds congregate in flocks of fifty to a hundred or more and feed progressively through the banana lots and fields.

202. SPOROPHILA INTERMEDIA Cabanis

Sporophila grisea Todd and Carriker.

Two were seen and one of them, an adult ♂, collected south of Rio Frio, October 27, in a bushy field. No others were ever surely identified.

203. SPOROPHILA LINEOLA RESTRICTA Todd

An adult ♂ shot July 5 at Rio Frio seems to be the first bird of this species to be recorded from the Santa Marta region, unless the specimen collected April 5, 1879, at Santa Marta by Simons (see *Sporophila*

sp., Todd and Carriker, p. 516) is the same thing. Birds of this species are fairly common in pairs or small flocks in the bushy abandoned land and semi-open about Rio Frio. The male has a quick, warbled song; the alarm note is a chirp with a "catty" quality. In its habits the species seems to be a typical *Sporophila*, feeding on the ground and in grass but sometimes resting in low trees.

204. Volatinia jacarini atronitens Todd

The *Volatinia* is abundant in grass lands and semi-open from Rio Frio up to at least 1,500 feet in the foothills. The male sings a wiry little song and, as he does so, pops a foot or two into the air and drops back to his perch, which is usually on an exposed twig in a low bush. Many individuals molting into the black plumage of the adult male were seen in February.

205. Sicalis flaveola flaveola (Linné)

The conspicuous yellow *Sicalis* is common in pairs in the semi-arid area from Sevillano to Santa Marta. It is to be seen feeding on the ground and resting in trees, in the cactus as well as the acacia thickets, and is common, too, in dry pastures and yards. Near Rio Frio it was noted only in early April, although birds were seen south of the town, near Orihueca, March 3 and late in March. I have no records for the species outside of the semi-arid area at any other season, and suspect that the individuals noted above, at and south of Rio Frio, were local migrants from a few miles north. My only specimen is an adult ♂ secured at Cienaga on November 11.

206. Arremon schlegeli Bonaparte

Not a single individual of *Arremon schlegeli* was seen on the coastal plain proper, although the bird is common just within the edge of the foothills east of Rio Frio. It usually feeds in pairs on the ground in forest underbrush, and is so tame that it may be approached very closely.

207. Arremonops conirostris conirostris Bonaparte

This large sparrow is usually found in pairs on the ground in abandoned land and other bushy places, but not, as a rule, in grass. It is rather shy and will often hide rather than fly. The male has a good song of several clear notes, rather deliberate for a sparrow, and the species can scold loudly. It is fairly common near Rio Frio.

208. Spiza americana (Gmelin)

Dickcissels are winter visitors of rather irregular occurrence. They were noted occasionally in fairly large flocks from October 1 to April 7, except that none was seen during December, January, and the first half of February. The species seemed commonest at Rio Frio, where an adult ♂ was secured October 1, but was noted also at Cienaga in February and on March 9. In both places its favorite haunts were in grassy fields which had been partly overgrown by bushes. The flocks fed on the ground, often rested in exposed shrubbery, and were surprisingly shy.